CHAPTER 24

ELECTRICAL POWER

LIST OF EFFECTIVE PAGES

N, R or D indicates pages which are New, Revised or Deleted respectively.

Remove and insert the affected pages and complete the Record of Revisions and the Record of Temporary Revisions as necessary.

CHAPTER 24

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CH/SE/SU	C	PAGE	DATE	CH/SE/SU	C	PAGE	DATE
24-00-00	01	154	Aug 30/80	24-00-00	01	A104	Aug 30/80
24-00-00	01	155	Aug 30/80	24-00-00	01	A105	Aug 30/80
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24-00-00	01	162	Aug 30/80	24-00-00	01	A112	Aug 30/80
24-00-00	01	163	Aug 30/80	24-00-00	01	A113	Aug 30/80
24-00-00	01	164	Aug 30/80	24-00-00	01	A114	Aug 30/80
24-00-00	01	165	Aug 30/80	24-00-00	01	A115	Aug 30/80
24-00-00	01	166	Aug 30/80	24-00-00	01	A116	Aug 30/80
24-00-00	01	167	Aug 30/80	24-00-00	01	A117	Aug 30/80
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24-00-00	01	169	Aug 30/80	24-00-00	01	A119	Aug 30/80
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24-00-00	02	A107	Aug 30/80	24-00-00		401	Nov 30/85
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24-00-00	02	A115	Aug 30/80	24-00-00		409	Feb 28/81
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24-11-11		401	May 30/76	24-11-11		803	May 30/76
24-11-11		402	Nov 30/85	24-11-11		804	May 30/76
24-11-11		403	Aug 30/77	24-11-11		805	May 30/76
24-11-11		404	Aug 30/75	24-11-11		802	May 30/76
24-11-11		405	May 30/81	24-11-11		807	Aug 30/81
24-11-11		406	May 30/81	24-11-11		808	May 30/76
24-11-11		407	May 30/81	24-11-11		809	May 30/76
24-11-11		408	Nov 30/85	24-11-21		401	Mar 29/96
24-11-11		409	Mar 29/96	24-11-21		402	Mar 29/96
24-11-11		410	May 30/81				
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24-11-11		411 B	Sep 30/92	24-12-00		3	May 30/81
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24-11-11		421	May 30/81	24-12-11		409	Nov 30/75
24-11-11		422	May 30/81	24-12-11		410	Nov 30/84
24-11-11		423	May 30/81	24-12-11		411	Nov 30/84
24-11-11		501	May 30/76	24-12-11		501	Nov 30/75
24-11-11		502	Aug 30/77	24-12-11		502	Nov 30/75
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24-11-11		504	May 30/77	24-12-12		402	May 30/81
24-11-11		505	Aug 30/77	24-12-12		403	May 30/81
24-11-11		506	Aug 30/77	24-12-12		404	May 30/81
24-11-11		601	Nov 30/80	24-12-12		405	May 30/81
24-11-11		602	Aug 30/75				
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24-11-11		604	Mar 31/95	24-21-00		2	May 30/76
24-11-11		605	Mar 31/95	24-21-00		3	May 30/76
24-11-11		606	Sep 30/87	24-21-00		4	Feb 29/80
24-11-11		607	Feb 28/81	24-21-00		5	May 30/76
24-11-11		608	Feb 28/81	24-21-00		6	May 30/76
24-11-11		609	Feb 28/81	24-21-00		7	May 30/76
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24-11-11		611	Mar 31/99	24-21-00		9	Aug 30/80
24-11-11		612	Feb 28/81	24-21-00		10	Aug 30/80
24-11-11		613	Feb 28/81	24-21-00		11	Aug 30/80
24-11-11		614	Feb 28/81	24-21-00		12	Aug 30/80
24-11-11		615	Feb 28/81	24-21-00		13	Nov 30/79

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24-21-00		18	Nov 30/79	24-21-21		11	Feb 29/80
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24-21-00		530	Aug 30/80	24-22-00		13	Aug 30/80
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24-21-00		602	Mar 31/98	24-22-00		16	May 30/80
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24-21-12		402	Feb 28/81	24-22-00		18	May 30/80
24-21-12		403	Feb 28/81	24-22-00		19	May 30/80
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24-21-21		3	Feb 29/80	24-22-00		22	Aug 30/80
24-21-21		4	Feb 29/80	24-22-00		23	May 30/80
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24-21-21		6	May 30/81	24-22-00		401	Nov 30/75

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24-22-00		406	Nov 30/75	24-22-22		403	Mar 29/96
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24-22-00		503	Aug 30/81	24-22-22		503	May 30/81
24-22-00		504	Aug 30/81				
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24-22-00		510	Aug 30/81	24-23-11		403	Aug 30/76
24-22-00		511	Aug 30/81	24-23-11		404	Aug 30/76
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24-22-00		514	Aug 30/81	24-24-00		2	Aug 30/81
24-22-00		515	Aug 30/81	24-24-00		3	Aug 30/81
24-22-00		516	Aug 30/81	24-24-00		4	Aug 30/81
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24-22-21		403	Mar 29/96	24-25-11		406	May 30/81
24-22-21		501	Aug 30/81	24-25-11		407	May 30/81
24-22-21		502	Aug 30/81				
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24-22-22		2	Feb 28/78	24-31-00		2	Aug 30/80

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24-31-00		7	Mar 31/99	24-31-11		404	Mar 30/01
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24-31-00		401	Nov 30/75	24-31-12		502	Sep 30/87
24-31-00		402	Nov 30/75	24-31-12		601	Nov 30/75
24-31-00		403	Nov 30/75	24-31-13		401	May 30/81
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24-31-00		405	Nov 30/75	24-31-13		403	May 30/81
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24-31-00	01	502	May 30/81	24-31-13		502	May 30/81
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24-31-00	01	504	May 30/81				
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24-31-00	01	506	May 30/81	24-41-00	01	2	Aug 30/80
24-31-00	01	507	May 30/81	24-41-00	01	3	Aug 30/80
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24-31-00	02	513	May 30/81	24-41-00	02	9	Aug 30/80
24-31-00	02	514	May 30/81	24-41-00	02	10	Aug 30/80
24-31-00	02	515	May 30/81	24-41-00	02	11	Aug 30/80

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24-41-00	02	13	Aug 30/80	24-41-00		402	Nov 30/79
24-41-00	02	14	Aug 30/80	24-41-00		403	Nov 30/79
24-41-00	02	15	Aug 30/80	24-41-00		404	Nov 30/79
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24-41-00	02	21	Aug 30/80	24-41-00		410	Aug 30/80
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24-41-00		115	Nov 30/79	24-41-11		402	Mar 29/96
24-41-00		116	Nov 30/79	24-41-12		401	Feb 29/76
24-41-00		117	Nov 30/79	24-41-12		402	Feb 29/76
24-41-00		118	Nov 30/79	24-41-12		403	Feb 29/76
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24-41-00	R	301	May 31/03	24-41-13		403	Feb 28/77
24-41-00	R	302	May 31/03	24-41-14		401	May 30/82
24-41-00	R	303	May 31/03	24-41-14		402	May 30/82
24-41-00	R	304	May 31/03	24-41-14		403	Feb 29/76
24-41-00	R	305	May 31/03	24-41-14		404	Feb 29/76
24-41-00	R	306	May 31/03	24-41-14		405	Feb 29/76
24-41-00	R	307	May 31/03				
24-41-00	R	308	May 31/03	24-50-00		401	Feb 29/80
24-41-00	R	309	May 31/03	24-50-00		402	Feb 29/80
24-41-00	R	310	May 31/03	24-50-00		403	Jun 30/75
24-41-00	R	311	May 31/03	24-50-00		404	Jun 30/75
24-41-00	R	312	May 31/03	24-50-00		405	Feb 29/80
24-41-00	D	313		24-50-00		406	Feb 29/80
24-41-00	D	314					
24-41-00	D	315		24-51-00		1	Aug 30/80

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24-51-00		3	Aug 30/80				
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24-52-00		11	Nov 30/81				
24-52-00		12	Nov 30/81				
24-52-00		13	Nov 30/81				
24-52-11		401	Nov 30/81				
24-52-11		402	Nov 30/81				
24-52-11		501	Nov 30/81				
24-52-11		502	Nov 30/81				

SERVICE BULLETIN LIST

In the following service bulletin list, SB indicates an aircraft manufacturers bulletin, AEB indicates an airline engineering bulletin and OL indicates an engine manufacturers bulletin (complete identification OL.593-XX-XXX).

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
AEBAF243005			Not applicable
SB 21-039		Feb 28/78	Embodied Air conditioning. Distribution -To trip electrical ground power in the absence of forward or aft rack cooling
SB 24-001			Embodied Electrical generation. Battery busbars -To change power supplies of specific L.P. fuel SOV motors and 2nd shot fire extinguisher bottles.
SB 24-002			Not applicable
SB 24-003			No effect Electrical power -DC generation -To change the existing type of battery to a battery with a fibre glass battery box
SB 24-004			Not applicable
SB 24-005			Applicable Electrical power -Introduction of electrical cable inspections
SB 24-005	01		Applicable Electrical power -Introduction of electrical cable inspections
SB 24-005	02		Applicable Electrical power -Introduction of electrical cable inspections
R SB 24-005	03		No effect Electrical power -Introduction of electrical cable inspections
SB 24-006			Not applicable
SB 24-007			Not applicable
SB 24-008			Not applicable
SB 24-009			No effect Electrical power -Cable harness -Servicing point supply re-routed at shelf 04-215 and 04-216. Flight compartment electronic racking
SB 24-010			No effect Electrical power -Cable guards -To introduce tufnol guards over looms near ceiling

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
			clamp strips
SB 24-011		Aug 30/77	Embodied
			Electrical power -Circuit breaker panel-To add check cord to panel 15-216
SB 24-012			No effect
			Electrical Power.Transformer Rectifier Unit (TRU) Ammeters-To equalise cable resistance
SB 24-012	01		Applicable
			Electrical Power.Transformer Rectifier Unit (TRU) Ammeters-To equalise cable resistance
SB 24-013			Not applicable
SB 24-013	01		Not applicable
SB 24-013	02		Applicable
			Electrical Power - Complement to MRB document. (Generator & I.D.G. inspection sample & oil change)
SB 24-014			Applicable
			Electrical power -General -To improve protection of electrical installation in the tail cone
SB 24-014	01		Applicable
			Electrical power -General -To improve protection of electrical installation in the tail cone
SB 24-014	02		Applicable
			Electrical power -General -To improve protection of electrical installation in the tail cone
SB 24-015			Applicable
			Electrical power -Main generator drive -To change the integrated drive generator (IDG) joint seal location
SB 24-016			Embodied
			Electrical power -Main generator drive -To improve interchangeability of integrated drive generators (Lucas BB.8903-24-6 and RR SB OL 72-118)
SB 24-017			No effect
			Electrical power-Dowty lever locked switches -Physical check
SB 24-018			No effect
			Electrical Power. Main AC Generation - To introduce a modified Generator control and Protection Unit (CPU)

SERVICE BULLETIN LIST

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
SB 24-018	01		No effect Electrical Power. Main AC Generation - To introduce a modified Generator control and Protection Unit (CPU)
SB 24-018	02		No effect Electrical Power. Main AC Generation - To introduce a modified Generator control and Protection Unit (CPU)
SB 24-019			Applicable Electrical generation -Check of 115/210 VAC standby invertor supplies and control
SB 24-020			Applicable Electrical power. Connectors -To introduce a method of preventing mis-mating between sub-panel 12-214 and the brake temperature panel
SB 24-020	01		Applicable Electrical power. Connectors -To introduce a method of preventing mis-mating between sub-panel 12-214 and the brake temperature panel
SB 24-021			Embodied Electrical power -Install spare flexible conduits in zones 165/166
SB 24-021	01		Applicable Electrical power -Install spare flexible conduits in zones 165/166
SB 24-022			Applicable Electrical Power - Improved contactor contact conditioning
SB 24-022	01		Applicable Electrical Power - Improved contactor contact conditioning
SB 24-022	02		No effect Electrical Power - To fit conditioned Main Power contactors
R SB 24-023		May 30/81	Embodied Electrical Power. Emergency Generator System - To modify the emergency start control logic
SB 24-023	01		Embodied Electrical Power. Emergency Generator System - To modify the emergency start control logic

SERVICE BULLETIN LIST

SB/AEB NO	REV	INC. IN REVISION	DESCRIPTION
SB 24-023	01	May 30/80	Embodied
SB 24-024			No effect Electrical Power. Integrated Drive generator - Revised maintenance requirements
SB 24-025			No effect Electrical generation - Improve electrical cable protection inside a cruciform and replace bracket assembly, in no.4 engine fuel compartment, zone 632
SB 24-025	01		No effect Electrical generation - Improve electrical cable protection inside a cruciform and replace bracket assembly, in no.4 engine fuel compartment, zone 632
SB 24-026			No effect Electrical generation. Main/essential bus bars - To change the electrical control of the wheel brakes from main to essential bus bars
SB 24-026	01		No effect Electrical generation. Main/essential bus bars - To change the electrical control of the wheel brakes from main to essential bus bars
SB 24-026	02		No effect Electrical generation. Main/essential bus bars - To change the electrical control of the wheel brakes from main to essential bus bars
SB 24-027			No effect Electrical power. General - To introduce modified clutch assembly into integrated dri generators for use with E.T.O 25 oil
SB 24A025			No effect Electrical power - Maintenance checks associated with superflexit loom PT. No. 36331
SB 24A025	01		No effect Electrical power - Maintenance checks associated with superflexit loom PT. No. 36331

CHAPTER 24

ELECTRICAL POWER

TABLE OF CONTENTS

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GENERAL - DESCRIPTION AND OPERATION

1. Introduction (Ref. Fig. 001)

Electrical power for the aircraft is obtained from engine-driven a.c. generators which supply power to the a.c. distribution system and, after conversion, to the d.c. distribution system. An emergency generation facility is provided, and also the means of supplying the aircraft with electrical power from a ground source.

2. Main AC Power

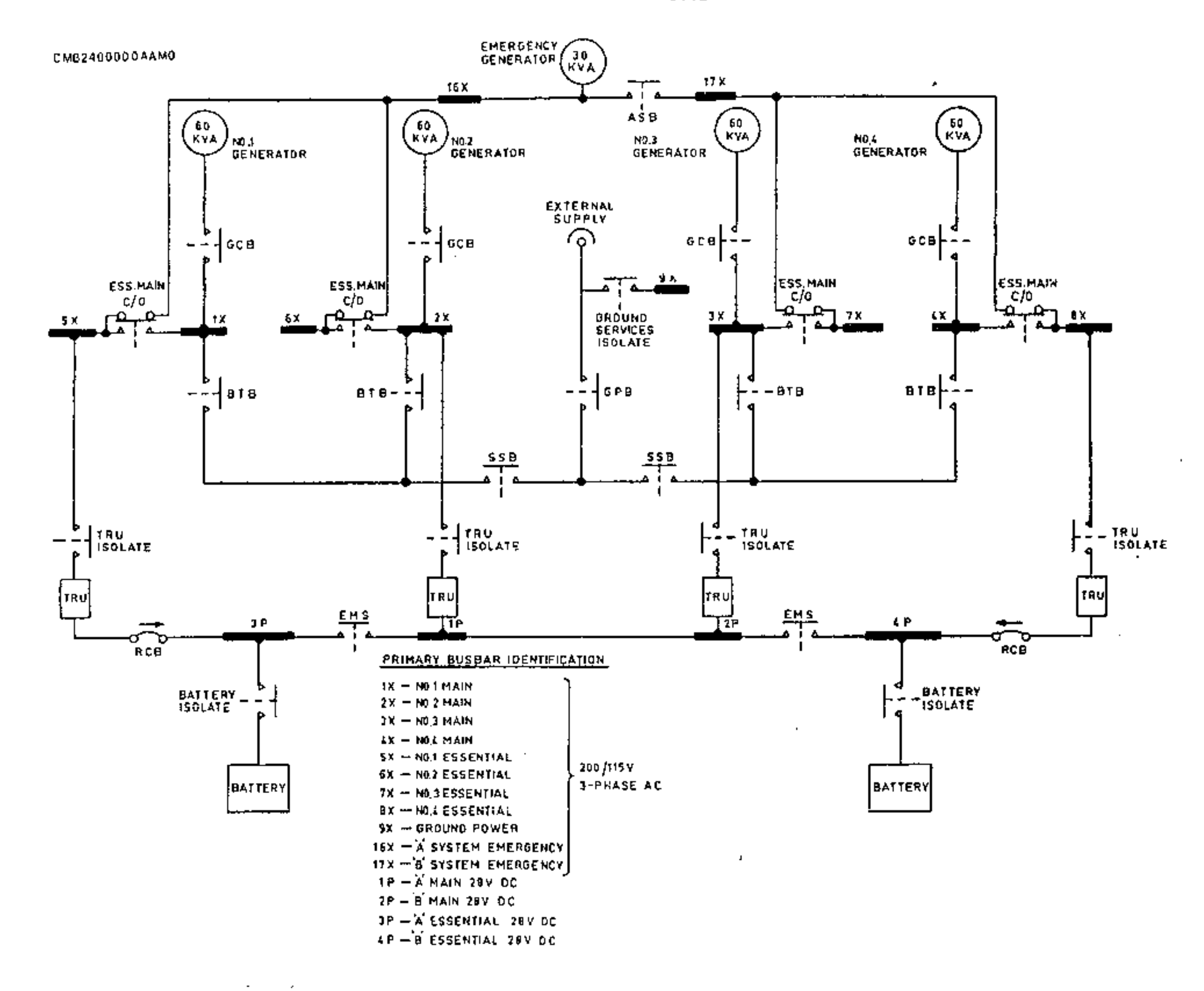
Main electrical power of 200/115 V three-phase 400 Hz a.c. is generated by four integrated drive generators (IDGs) mounted one on each engine. Each IDG is a self-contained unit consisting of a 60 kVA generator and an axial gear differential transmission which drives the generator at a constant speed throughout the normal operating speed of the engine.

Each generator feeds separate main a.c. busbars through generator circuit breakers (GCBs) and interconnection of the main a.c. busbars is effected by bus-tie breakers (BTBs) and split system breakers (SSBs). Control of the system is mainly automatic and normally all four generators operate in parallel, but manual control of the GCBs, BTBs and SSBs is provided to permit isolation of a power source or single or parallel combinations of generator operation as required.

3. Emergency AC Power

Four essential a.c. busbars are normally connected one to each main a.c. busbar by an essential/main change-over (ESS. MAIN C/O) contactor. These contactors operate in an emergency generation control system so that in the event of loss of power on any main a.c. busbar the appropriate essential a.c. busbar is automatically transferred to the output of an emergency 30 kVA generator. Associated control switches enable such transfer to be effected manually if necessary.

The emergency 30 kVA generator is driven by a constant-speed hydraulic motor supplied from either the main engine-driven pumps of Nos.1 and 2 engines (green system) or a pump driven by an emergency power unit (ram air turbine). The essential a.c. busbars are arranged so that in the event of failure involving Nos.1 and 2 engines, an auto-shed breaker (ASB) operates to shed all essential loads other than those essential for engine relight and aircraft handling.



Electrical Power - Simplified Schematic
Figure 001

4. DC Power

Four transformer rectifier units (TRUs) are supplied with three-phase a.c. power and provide 28 V d.c. power. Two TRUs are supplied from main a.c. busbars and the outputs are each directly connected to a main d.c. busbar. The other two TRUs are supplied from essential a.c. busbars and the outputs are each fed through a reverse current breaker (RCB) to an essential d.c. busbar. Each essential d.c. busbar is also supplied by a battery of approximately 25 Ah capacity. The two main d.c. busbars are linked by a cable and heavy-duty fuses, and the d.c. essential busbars are connected to the main d.c. busbars through essential/main split contactors (EMSs) which open automatically with main d.c. busbar under-voltage.

5. External Power

Provision is made for the connection of a 200/115 V three-phase 400 Hz a.c. supply to the aircraft from a ground source. This supply is connected through a ground services isolate contactor to a ground power busbar from which the supply is distributed to certain selected ground services. The supply can be further connected to the main a.c. distribution system through a ground power breaker (GPB) and, therefore, will also supply the d.c. distribution system via the TRUs.

6. Distribution

The majority of aircraft electrical services are supplied from busbars, via circuit breakers, within the flight compartment. Circuit breakers for emergency and essential services are panel-mounted on the left side; the remainder are panel-mounted above the racked equipment at the rear of the compartment.

7. Operation

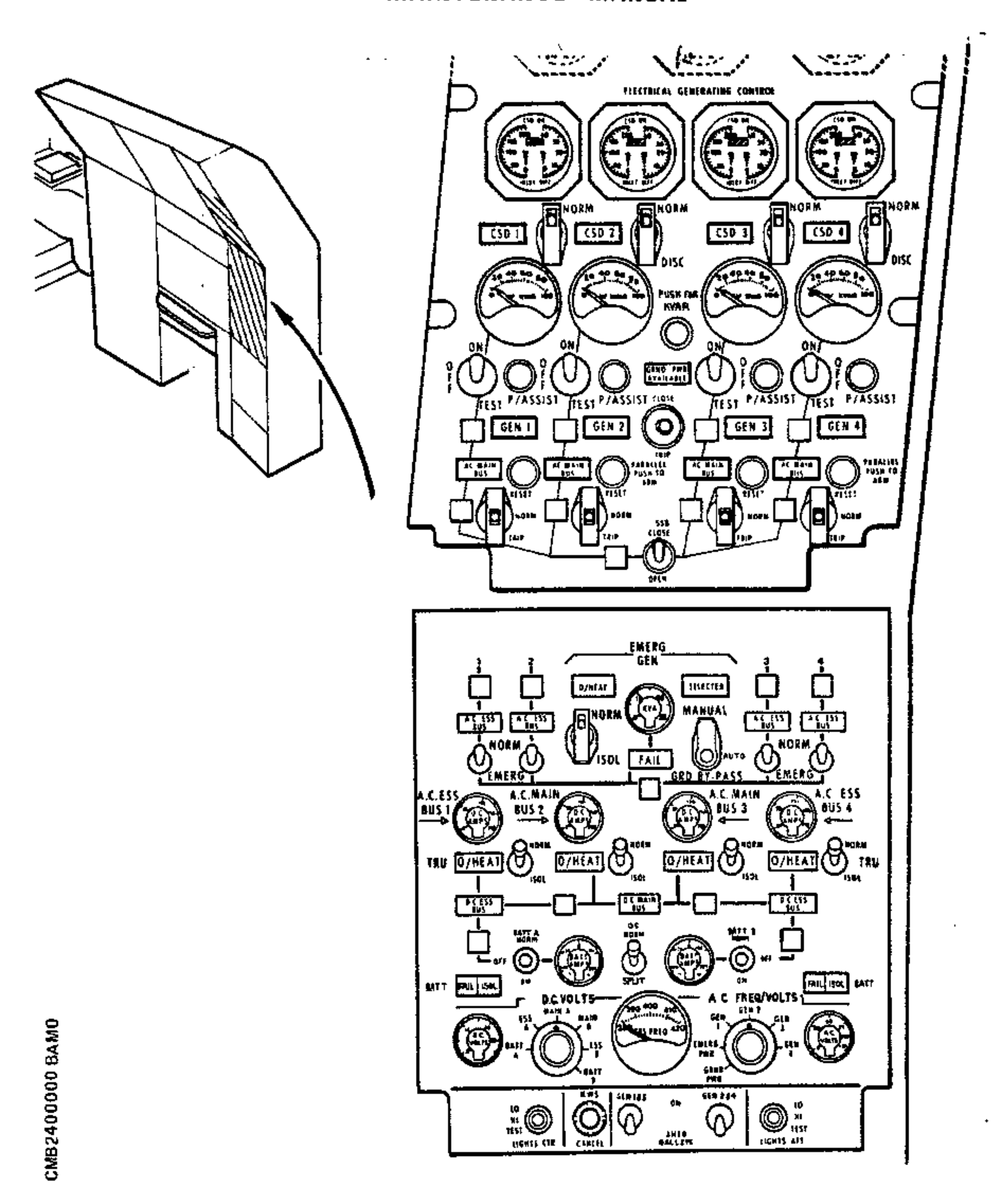
R **ON A/C 007-007,

(Ref. Fig. 002)

R **ON A/C 001-006,

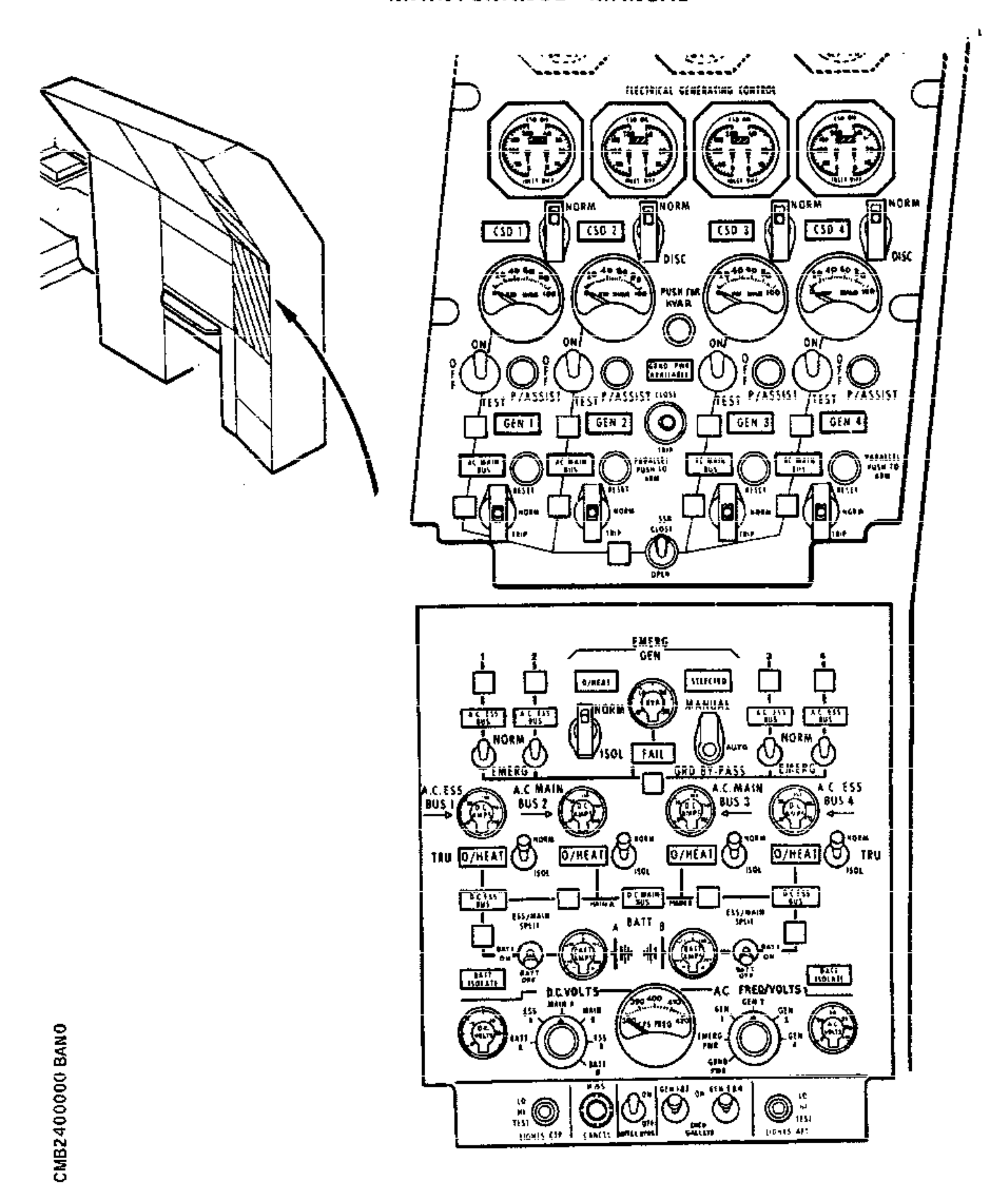
(Ref. Fig. 003)

Control and indication for electrical power is provided on the electrical generating control section of the third crew member's management panels. Load-indicating meters, caption lights, magnetic indicators and controls are



CMB2400000 BAM0

Controls and Indicators
Figure 002



Controls and Indicators
Figure 003

logically positioned with respect to etched lines representing busbar layout and interconnections, which provide a pictorial presentation of the electrical system and its operation. The filaments in all caption lights on the electrical generating control panel can be tested by the flight compartment lights test and dimming facility. (Ref. 33-14-00). In addition, the majority of caption lights incorporate a press-to-test facility. All red and amber caption lights are connected to the master warning system (Ref. 33-15-00). Control for the ground services isolate contactor is provided by a switch on the steward's panel in the forward vestibule.

As previously stated, system operation is mainly automatic. Thus, normally, it is necessary only to monitor system operation by visual reference to the control panels, but selective switching facilities enable non-standard configurations to be established, e.g., those required by smoke drill.

R **ON A/C 007-007,

GENERAL - TROUBLE SHOOTING

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN SERVICING AND THE HYDRAULIC SAFETY PRECAUTIONS DETAILED IN 29-00-00.

1. General

Faults are dealt with on a probability basis and identified as a result of testing.

The defect can be isolated with the aid of trouble shooting procedures (Ref. paras.3. to 14. inclusive), and traced through IF OK and IF NOT OK paths to the appropriate charts or other specified rectification action as may be necessary. If a defect occurs, perform the appropriate rectification action, then repeat the operation at which the defect was encountered to ensure that the operation is OK.

Bracketed numbers in the preparation procedures and charts indicate items on the component identification table (Ref. Table 103). The table provides information, including component location, required for rectification. Component location also indicates the possible necessity of repositioning certain items of ground service equipment. Each chart also specifies the ground equipment required for that particular task.

All procedures dealing with trouble shooting are based on the assumption that electrical wiring is serviceable, all associated circuit breakers are set and electrical power is available, unless otherwise stated. If the fault is not rectified, check the wiring in accordance with the Wiring Diagram Manual (Ref. Table 103).

This topic contains trouble shooting in sections directly related to the Operational and Functional Tests (Ref. 24-00-00, Adjustment/Test) of the Electrical Power System. The first section is designated 'Preliminary' for trouble shooting procedures applied to the Operational Test; the subsequent sections follow the sequence of the individual Functional Test procedures.

The circuits for Nos.1, 2, 3 and 4 generation channels are similar. Therefore, where equipment identical in each channel is involved, trouble shooting for No.1 channel is given by the first component identification reference (Table 103) and for Nos.2, 3 and 4 channels in that order, by the subsequent component references. E.g., on Chart 102 - Check

for 28 V d.c. at terminal 2 of AC MAIN BUS Caption Light Module (17), (18), (19), or (20) - (17) - channel 1, (18) - channel 2, etc.

2. Preparation

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

NOTE: The required preparation instructions are selected as detailed in the relevant section of the trouble shooting procedures, paragraph 3. et seq.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Throttle control system test set, required for Emergency Generation Preliminary procedures (Ref. para.C.)	QTA16-24
Decade resistance boxes, range 100 - 200 ohm (two), required for Emergency Generator Overheat Indication procedures (Ref. para.D.)	-
Test lamps, 28 V (four), required for 26 V 400 Hz AC Generation procedures (Ref. para.E.)	-
Neon test indicators, 115 V (two), required for 'A' and 'B' Avionics 115 V 400 Hz AC Busbars procedures (Ref. para.F.)	-
Test lamp, 28 V (one), required for 115/26 V AC Standby Inverter Supplies and Control procedures (Ref. para.G.)	-
Precision-grade a.c. voltmeter, range 110 - 125 V a.c., required for 115/26 V AC Standby Inverter Supplies and Control procedures	-

DESCRIPTION	PART NO.
(Ref. para.G.)	
Precision-grade frequency meter, range 350 - 450 Hz, required for 115/26 V AC Standby Inverter Supplies and Control procedures (Ref. para.G.)	-
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN), required for DC Essential/Main Split - AC Undervolt Control (Ref. para.H.)	-
Dormant circuit test test, required for Main Generation Dormant Circuits (Ref. para.J.)	TE.5002.000

B. Preliminary

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

C. Emergency Generation - Preliminary (Including Auto-shed Breaker)

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN AND THE GREEN HYDRAULIC SYSTEM MUST NOT BE PRESSURIZED DURING THESE PROCEDURES.

CAUTION: SUBSEQUENT PROCEDURES REQUIRE THE TRIPPING OF CIRCUIT BREAKERS, TO ESTABLISH LEFT-HAND AND RIGHT-HAND WEIGHT SWITCH OPERATED RELAYS IN THE 'IN-FLIGHT' POSITION. CARE MUST BE TAKEN TO ENSURE THAT ALL SERVICES ADVERSELY AFFECTED BY THIS CONDITION ARE PREVIOUSLY ISOLATED (REF. 7-11-00).

(1) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(2) Make available electrical ground power as detailed in 24-41-00.

(3) Trip the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Fit safety clips to the tripped circuit breakers.

(4) Gain access to the engine control amplifiers (throttle amplifiers) mounted on shelves 6-215 and 8-215 by removing the appropriate panels from the flight compartment left-hand racking.

(5) Locate No.1 engine main control amplifier (1K20) mounted on shelf 8-215, and No.2 engine main control amplifier (2K20) mounted on shelf 6-215.

(6) On the pilot's roof panel, 4-211, ensure that -

(a) No.1 engine and No.2 engine AUTO-IGNITION control switches are set to OFF,

(b) No.1 engine and No.2 engine HP VALVE control switches are set to SHUT, and

(c) No.1 engine and No.2 engine THROTTLE MASTER switches are set to OFF.

(7) Place a warning placard in the flight compartment forbidding alteration of the switch settings specified in paragraphs (6)(a), (b) and (c).

NOTE: The setting of Nos. 1 and 2 engine throttle levers is not significant.

(8) Connect the throttle control system test set cable 2 between connector socket PL 2 on the test set and connector socket SKT 2 on the front of No.1 engine main control amplifier (1K20).

(9) Ensure that the emergency generator isolate switch is at NORM. Set the emergency generator mode switch to "GRD BY-PASS" and ensure that the emergency generator SELECTED and FAIL captions are illuminated.

NOTE: The following test procedures do not require

the setting of any control on the test set to a particular position.

D. Emergency Generator Overheat Indication

WARNING: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Trip, and fit a safety clip to, the EMER GEN AUTO CONT circuit breaker X212 (93), and the EMER GEN MANL CONT circuit breaker X211 (90).

(2) Gain access to the emergency generator by opening access door 153 DB (Ref. 52-41-41) and disconnect electrical connector X200-A from the emergency generator.

(3) Connect one decade resistance box between pins A and B of the free connector X200-A and another decade resistance box between pins G and H. Set each box at 100 ohm.

(4) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 (93).

(5) Make available electrical ground power as detailed in 24-41-00.

(6) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(7) Set the emergency generator mode switch to "GRD BY-PASS"; ensure that the emergency generator SELECTED and FAIL captions are illuminated.

E. 26 V 400 Hz AC Generation

WARNING: DURING THESE PROCEDURES ENSURE THAT ALL AIRCRAFT-GENERATED SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Trip the 'A' SYS 26 V AC TRANS SUP circuit breaker 1X131 (105) and the 'B' SYS 26 V AC TRANS SUP circuit breaker 2X131 (106). Fit safety clips to the tripped circuit breakers.

(4) Gain access to the 26 V a.c. 'A' and 'B' main busbars on panels 13-215 and 13-216 respectively and to the 26 V a.c. 'A' and 'B' essential busbars on panels 2-213 and 4-213 respectively, by opening these circuit breaker panels.

(5) Connect test lamps between each 26 V a.c. busbar and earth; test lamp connection points, suitable for each busbar are as follows:-

(a) 'A' main busbar: terminal 1 of circuit breaker D81 on panel 13-215, map ref.D1.

(b) 'B' main busbar: terminal 1 of circuit breaker H1010 on panel 13-216, map ref.D19.

(c) 'A' essential busbar: terminal 1 of circuit breaker 1F78 on panel 2-213, map ref.A2.

(d) 'B' essential busbar: terminal 1 of circuit breaker D211 on panel 4-213, map ref.E3.

(6) Remove the safety clips and reset the circuit breakers tripped in operation (3).

(7) Remove the warning placard and switch on ground power at source.

F. 'A' and 'B' Avionics 115 V 400 Hz AC Busbars

WARNING: DURING THESE PROCEDURES ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Trip the AVIONIC LOAD SHED 'A' SYS SUP circuit breaker 1X520 (113) and the AVIONIC LOAD SHED 'B' SYS SUP circuit breaker 2X520 (114). Fit safety

clips to the tripped circuit breakers.

(4) Gain access to the 115 V a.c. 'A' and 'B' avionics busbars on panels 13-215 and 13-216 respectively, by opening these circuit breaker panels.

(5) Connect 115 V neon test indicators, one between each 115 V avionics busbar and earth. Neon indicator connection points, suitable for each busbar, are as follows:-

(a) 'A' avionics busbar: terminal 1 of circuit breaker 1C18 on panel 13-215, map ref.A5.

(b) 'B' avionics busbar: terminal 1 of circuit breaker 2S4 on panel 13-216, map ref.G19.

(6) Remove the safety clips and reset the circuit breakers tripped in operation (3).

(7) Remove the warning placard and switch on ground power at source.

G. 115/26 V AC Standby Inverter Supplies and Control

WARNING: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Isolate the 115 V and 26 V a.c. standby busbars by tripping the 115 V A.C. STBY TRANS SUP circuit breaker X137 (115). Fit a safety clip to the tripped circuit breaker.

(4) Gain access to the 115 V and 26 V a.c. standby busbars on panel 2-213 by opening this circuit breaker panel.

(5) Connect the 110 - 125 V a.c. voltmeter and the 350 - 450 Hz frequency meter between the 115 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker X134 on panel 2-213, map ref.C18, as a suitable point for connection of the voltmeter and

frequency meter to the busbar.

(6) Connect a 28 V test lamp between the 26 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker 1F88, map ref.B1, as a suitable point for connection of the test lamp to the busbar.

(7) Remove the safety clip and reset the circuit breaker tripped in operation (3).

(8) Remove the warning placard and switch on ground power at source.

H. DC Essential/Main Split - AC Undervolt Control

WARNING: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Gain access to No.3 main a.c. undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover, then disconnect and secure the cable from terminal 4 (earth) of the undervolt unit. Fit the terminal cover, then close amd secure the circuit breaker panel.

NOTE: The torque screwdriver (Ref. para.A.) is required for the subsequent reconnection of the cable to terminal 4 of the undervolt unit.

(4) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT.A and BATT.B control switches to "ON" and ensure that the DC NORM/SPLIT switch is at NORM. Ensure that No.3 AC MAIN BUS and No.3 AC ESS BUS captions are illuminated, and that both 'A' and 'B' system essential/main split magnetic indicators display in-line.

(5) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(6) Set Nos.1,2 and 4 bus-tie breaker (BTB) control switches to "TRIP". Ensure that Nos.1, 2, 3 and 4 AC MAIN BUS and AC ESS BUS captions are illuminated, and that both 'A' and 'B' system essential/main split magnetic indicators display cross-line.

(7) Check, by observing No.3 TRU ammeter, that No.3 TRU is supplying the 'B' system main busbar.

I. Battery Charge Control

(1) Ensure that 'A' battery and 'B' battery are serviceable and fully charged.

(2) Make available electrical ground power as detailed in 24-41-00.

(3) Open the forward underfloor service compartment door (123 AB) (Ref. 52-41-11) to permit access to 'A' battery charge controller (1P35) and 'B' battery charge controller (2P35), mounted on the top surface of the weather radar racking in the forward underfloor racking zone.

(4) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(5) Check that the DC NORM/SPLIT switch is set to NORM.

(6) Check that both 'A' and 'B' battery control switches are set to OFF and that the associated 'battery isolate' magnetic indicators display cross-line.

(7) Check at 'A' and 'B' BATT - FAIL/ISOL captions that the ISOL section of each is illuminated and the FAIL section of each is extinguished.

J. Main Generation Dormant Circuits

CAUTION: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Connect electrical ground power to the ground services distribution system only (Ref. 24-41-00,

Servicing, para.2.A.). If already connected, ensure that ground power is disconnected from the main a.c. distribution system by operation of the ground power control switch to the TRIP position.

(2) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(3) Gain access to Nos.1, 2, 3 and 4 control and protection units (128), (129), (130) and (131) by removing the appropriate panels from the flight compartment racking.

(4) Ensure that BATT A and BATT B control switches are set to OFF.

(5) Set all four generator control switches to "OFF".

(6) Check that the SSB control switch is at CLOSE, the BTB control switches are at NORM, the GCB magnetic indicators display cross-line, the BTB magnetic indicators display in-line and the fault indicators on the front of all four control and protection units (CPUs) display 'all black' (no faults).
If the test is to be applied after generation system operation has resulted in a specific fault indication on a CPU (fault indicator displays white), record the fault indication, then reset the indicator by activating the adjacent INDICATOR RESET switch.

(7) Check that the 28 V supply switch on the dormant circuit test set is set to OFF and that all other switches on the test set are set to position 1.

(8) Using the appropriate cable loom and connector supplied therewith, connect the test set to the connector on the front of No.1 CPU.

NOTE: The 28 V d.c. external supply connector on the test set is not used for dormant circuit tests.

K. Emergency Generation - Using Hydraulic Ground Power

CAUTION: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THESE PROCEDURES.

(1) Check that all a.c. supplies are inhibited and that d.c. power is switched off.

(2) Ensure that operation of the emergency generator control circuits has been checked and cleared in accordance with the procedures detailed in paragraph 4., Emergency Generation - Preliminary.

(3) Open circuit breaker panel 1-213 to permit observation of the 'power on' neon indicator lamps that are mounted together on a panel at the end of shelF 12-215 and identified in Table 101.

NEON LAMP	'POWER ON' INDICATION
1X233	No.1 engine relight busbar
2X233	No.2 engine relight busbar
3X233	No.3 engine relight busbar
4X233	No.4 engine relight busbar
X232	Emergency generator

Neon Indicator Lamps on Panel at End of Shelf 12-215
Table 101

(4) Open circuit breaker panels 2-213 and 4-213 to permit observation of the neon indicator lamps that are mounted on the inner face of each panel and identified in Table 102.

NEON LAMP	PANEL	'POWER ON' INDICATION
1X136	2-213	No.1 a.c. essential busbar
2X136	2-213	No.2 a.c. essential busbar
3X136	4-213	No.3 a.c. essential busbar
4X136	4-213	No.4 a.c. essential busbar

Neon Indicator Lamps on Panels 2-213 and 4-213
Table 102

(5) Remove the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00) to permit access to the emergency generator control and protection unit on shelf 5-243.

(6) Make available electrical ground power as detailed in 24-41-00.

(7) Connect and supply ground hydraulic power to the 'green' hydraulic system (Ref. Chap.29).

(8) Set BATT A and BATT B control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line. Check also that the d.c. essential/main split magnetic indicators display in-line.

(9) Ensure that the EMERG RELIGHT BUSBAR selector switch on the engine starting panel (18-214) is set to OFF.

L. AC and DC Generation Master Warning

CAUTION: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Open the engine bay doors as required to gain access to Nos.1, 2, 3 and 4 integrated drive generators (IDGs) (Ref. 71-00-00).

(2) Make all four CSD failure warning circuits inoperative by disconnecting the electrical connector from the oil low pressure warning switch at each IDG, i.e., connector 1X1-C (No.1 IDG), 2X1-C (No.2 IDG), 3X1-C (No.3 IDG) and 4X1-C (No.4 IDG).

(3) Isolate all four generator (GEN) failure warning indication circuits by tripping the No.1 & 2 GEN FAIL WARN IND circuit breaker 1X12 (181) and the No.3 & 4 GEN FAIL WARN IND circuit breaker 4X12 (182). Fit safety clips to the tripped circuit breakers.

(4) Make available electrical ground power as detailed in 24-41-00.

(5) Ensure that the electrical power distribution system is set for normal operation, i.e., that the setting of controls and indicators is in accordance with the requirements for the connection of electrical ground

power to the main a.c. distribution system (Ref. 24-41-00, Servicing, para.2.B.).

(6) Check that all caption filaments are serviceable (Ref. 33-14-00).

(7) Open the forward underfloor service compartment door (123 AB) (Ref. 52-41-11) to permit access to 'A' battery charge controller (1P35) and 'B' battery charge controller (2P35), mounted on the top surface of the weather radar racking in the forward underfloor racking zone.

(8) On the electrical generating control panel, check that the GRND PWR AVAILABLE caption and both BATT ISOLATE captions are illuminated and that all other captions are extinguished.

(9) Ensure that both battery control switches are set to OFF and check that only the ISOL sections of both BATT - FAIL/ISOL captions are illuminated.

(10) Press the RECALL button on the master warning display panel; some master warning captions may be illuminated. Press the face of each illuminated caption on the master warning display panel and check that each is extinguished (warning cancelled).

M. AC Generation - Using Main Engines

(1) Ensure that the aircraft power unit installation and systems are cleared and safe for the ground running of all four engines to be carried out (Ref. 71-00-00).

(2) Ensure that the integrated drive generator (IDG) fitted to each engine has been cleared for running (Ref. 24-11-11, Inspection/Check) and that the transmission (constant speed drive) is engaged.

(3) Make available electrical ground power as detailed in 24-41-00.

(4) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(5) Ensure that the electrical power distribution system is set for normal operation, i.e., that the setting of controls and indicators is in accordance with the requirements for the connection of electrical ground power to the main a.c. distribution system

(Ref. 24-41-00, Servicing, para.2B.).

(6) Ensure that all four generator control switches are set to ON.

(7) In readiness for engine starting, set BATT A and BATT B control switches to "ON", checking that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

CAUTION: IF A CSD (CONSTANT SPEED DRIVE) FAILURE CAPTION REMAINS ILLUMINATED AFTER THE ASSOCIATED ENGINE HAS RUN UP TO A SPEED OF 62 PER CENT N2 OR ABOVE, ABNORMAL OPERATION OF THE IDG IS INDICATED. THE CSD DISCONNECT SWITCH MUST THEN BE OPERATED TO THE "DISC" POSITION TO EFFECT DISENGAGEMENT OF THE IDG TRANSMISSION.

DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

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3. Trouble Shooting - Preliminary

NOTE: Before renewal of components (*), check the associated wiring for continuity.

A. *Prepare to trouble shoot (Ref. para.2.B.). Set BATT A and BATT B control switches to "ON". Check that the associated battery isolate magnetic indicators change from cross-line to in-line. IF -

- OK — go to B.
- NOT OK — Magnetic indicator remains cross-line - Chart 101.

B. *Set BATT A and BATT B control switches to "NORM" and check that the associated 'battery isolate' magnetic indicators remain in-line. IF -

- OK — go to C.
- NOT OK — 'A' or 'B' magnetic indicator moves to cross-line - check for 28 V d.c. output at terminal 2 of CB (233) or (234). If absent, renew CB (233) or (234); if present, check for earth potential at terminal 9 of Battery Control Switch (9) or (10); if YES, renew Battery Control Switch (9) or (10); if NO, *renew Battery Charge Controller (235) or (236).

C. *Set the DC NORM/SPLIT control switch to "SPLIT". Check that both 'A' and 'B' essential/main split magnetic indicators display cross-line and that both 'A' and 'B' 'battery isolate' magnetic indicators remain in-line. IF -

```
                 |       |
                 |       |              -----------------------------------
                 |       |             |1. Both (A and B) essential/main    |
                 OK      NOT OK-------|    split magnetic indicators remain|
                 |                     |    in-line - *renew DC NORM/SPLIT  |
                 |                     |    Control Switch (232).           |
                 |                     |2. Either (A or B) essential/main  |
                 |                     |    split magnetic indicator remains|
                 |                     |    in-line - Chart 102.            |
                 |                     |3. Either (A or B) 'battery        |
                 |                     |    isolate' magnetic indicator     |
                 |                     |    moves to cross-line - renew     |
                 |                     |    Battery Charge Controller (235) |
                 |                     |    or (236).                       |
                 |                      -----------------------------------
                 |
D.********************************************
  *Set the DC NORM/SPLIT control switch to   *
  *"NORM" and BATT A and BATT B control      *
  *switches to "ON". Check that both A and   *
  *B essential/main split magnetic indicators*
  *return to in-line.  IF -                  *
  ********************************************
                 |       |
                 |       |              -----------------------------------
                 |       |             |Either (A or B) essential/main     |
                 OK      NOT OK-------|split magnetic indicator remains   |
                 |                     |cross-line - refer to Trouble      |
                 |                     |Shooting of the External Power     |
                 |                     |System (Ref. 24-41-00).            |
                 |                      -----------------------------------
```

```
                |
                |
E.*********************************************
  *Set the split system breaker (SSB) control*
  *switch to "OPEN" and check that both SSBs *
  *open, by observing that all four AC MAIN  *
  *BUS captions are illuminated and that the *
  *SSB position magnetic indicators change   *
  *from in-line to cross-line.  IF -         *
  ********************************************
                |    |
                |    |                ----------------------------------
                |    |               |1. Nos.1 and 2 AC MAIN BUS captions|
                OK   NOT OK------|      remain extinguished - renew No.1|
                |                    |   SSB (13).                       |
                |                    |2. Nos.3 and 4 AC MAIN BUS captions|
                |                    |   remain extinguished - renew No.2|
                |                    |   SSB (14).                       |
                |                    |3. One AC MAIN BUS  caption remains|
                |                    |   extinguished - Chart 103.       |
                |                    |4. All four AC MAIN BUS captions   |
                |                    |   remain extinguished, SSB        |
                |                    |   position magnetic indicator     |
                |                    |   remains in-line - renew SSB     |
                |                    |   Control Switch (15).            |
                |                    |5. All four AC MAIN BUS captions   |
                |                    |   illuminated, SSB position       |
                |                    |   magnetic indicator remains in-  |
                |                    |   line - renew SSB Position       |
                |                    |   Magnetic Indicator (16).        |
                |                     ----------------------------------
                |
F.*********************************************
  *Return the SSB control switch to "CLOSE". *
  *Set Nos.1, 2, 3 and 4 bus-tie breaker     *
  *(BTB) control switches to "TRIP", in,turn *
  *and check that the associated BTB         *
  *position and essential/main isolate       *
  *magnetic indicators change from in-line   *
  *to cross-line and the AC MAIN BUS and     *
  *AC ESS BUS captions are illuminated.  IF -*
  ********************************************
                |    |
```

OK NOT OK

1. The BTB position and essential/ main isolate magnetic indicators remain in-line and the associated AC MAIN BUS and AC ESS BUS captions remain extinguished in any one channel - renew BTB Control Switch (37), (38), (39) or (40).
2. A BTB position magnetic indicator shows cross-line with the associated essential/main isolate magnetic indicator in-line and the AC MAIN BUS and AC ESS BUS captions extinguished - renew Bus-tie Breaker (33), (34) (35) or (36).
3. A BTB position magnetic indicator shows in-line with all other associated channel indications correct - renew BTB Magnetic Indicator (29), (30), (31) or (32).
4. An essential/main isolate magnetic indicator shows in-line with all other associated channel indications correct - Chart 104.
5. Either Nos.1 and 2 of Nos.3 and 4 AC ESS BUS captions remain extinguished - renew CB (62) or (63).
6. One AC ESS BUS caption remains extinguished - Chart 105.

```
              |
G.*********************************************
  *Return Nos.1, 2, 3 and 4 BTB control       *
  *switches to "NORM", then set each trans-   *
  *former rectifier (TRU) control switch to   *
  *"ISOL".  Check that each TRU ammeter       *
  *indication falls to zero as the associated*
  *ISOL setting is made.  When the last TRU   *
  *is isolated allow 10 s to elapse then      *
  *check that the DC MAIN BUS caption is      *
  *illuminated and both A and B essential/    *
  *main split magnetic indicators display     *
  *cross-line.  IF -                          *
  *********************************************
              |     |
              |     |         ------------------------------------
              |     |        |1. TRU ammeter indicates load, all |
              OK    NOT OK------|   system indications correct -    |
              |              |   renew Ammeter (64), (65), (66)  |
              |              |   or (67).                        |
              |              |2. TRU ammeter indicates load with |
              |              |   DC MAIN BUS caption             |
              |              |   extinguished, 'A' and 'B'       |
              |              |   essential/main split magnetic   |
              |              |   indicators in-line and all TRU  |
              |              |   isolate switches at 'ISOL' -    |
              |              |   Chart 106.                      |
              |              |3. DC MAIN BUS caption remains     |
              |              |   extinguished - Chart 107.       |
              |              |4. Essential/main split magnetic   |
              |              |   indicator remains in-line -     |
              |              |   Chart 108.                      |
              |               ------------------------------------
              |
H.*********************************************
  *With the four TRUs isolated, set BATT A    *
  *control switch to "OFF" and check          *
  *that 'A' system DC ESS BUS caption is      *
  *illuminated.  IF -                         *
  *********************************************
              |     |
              |     |         ------------------------------------
              |     |        |'A' system DC ESS BUS caption      |
              OK    NOT OK------|remains extinguished - Chart 109.  |
              |               ------------------------------------
              |
```

```
         |
I.********************************************
  *With the four TRUs isolated, return BATT A*
  *control switch to "ON" and set BATT B     *
  *control switch to "OFF" and check         *
  *that 'B' system DC ESS BUS caption is     *
  *illuminated.  IF -                        *
  ********************************************
           |    |
           |    |        ----------------------------------
           |    |       |'B' system DC ESS BUS caption     |
           OK   NOT OK------|remains extinguished - Chart 109. |
           |             ----------------------------------
           |
J.********************************************
  *Return all four TRU control switches to   *
  *"NORM" and the BATT B control switch to   *
  *"ON", and then set the emergency          *
  *generator mode switch to "MANUAL".  Check *
  *that the SELECTED and FAIL captions are   *
  *illuminated.  IF -                        *
  ********************************************
           |    |
           |    |        ----------------------------------
           |    |       |1. SELECTED caption remains       |
           OK   NOT OK------|   extinguished - renew SELECTED  |
           |            |   Caption Light Module (86).     |
           |            |2. FAIL caption remains exting-   |
           |            |   uished - Chart 110.            |
           |            |3. SELECTED and FAIL captions     |
           |            |   remain extinguished - Chart 111.|
           |             ----------------------------------
           |
K.********************************************
  *With the emergency generator mode switch  *
  *at MANUAL set the emergency generator     *
  *isolate switch to "ISOL".  Check that the *
  *SELECTED and FAIL captions are exting-    *
  *uished.  IF -                             *
  ********************************************
           |    |
           |    |        ----------------------------------
           |    |       |SELECTED and FAIL captions remain |
           OK   NOT OK------|illuminated - renew Emergency     |
           |            |Generator Isolate Switch (91).    |
           |             ----------------------------------
           |
           |
           |
```

```
L.*****************************************
 *Return the emergency generator isolate    *
 *switch to "NORM" and set the emergency    *
 *generator mode switch to "GRD BY-PASS".   *
 *Check that the SELECTED and FAIL captions *
 *are illuminated.  IF -                    *
 *****************************************
            |    |
            |    |     ------------------------------------
            |    |    |SELECTED and FAIL captions are      |
            OK   NOT OK------|extinguished - Chart 112.    |
            |          ------------------------------------
            |
M.*****************************************
 *Set the emergency generator isolate switch*
 *to "ISOL" and check that the SELECTED and *
 *FAIL captions are extinguished.  IF -     *
 *****************************************
            |    |
            |    |     ------------------------------------
            |    |    |SELECTED and FAIL captions remain   |
            OK   NOT OK------|illuminated - renew Emergency |
            |         |Generator Isolate Switch (91).      |
            |          ------------------------------------
            |
N.*****************************************
 *Return the emergency generator mode switch*
 *to "AUTO" and the isolate switch to       *
 *"NORM". Check that the SELECTED and FAIL  *
 *captions are not illuminated.  IF -       *
 *****************************************
            |    |
            |    |     ------------------------------------
            |    |    |SELECTED and FAIL captions illumi-  |
            OK   NOT OK------|nated - Chart 113.           |
            |          ------------------------------------
            |
O.*****************************************
 *Set BATT A and BATT B control switches to *
 *"OFF". Check that the ISOL sections of the*
 *'A' system and 'B' system BATT - FAIL/ISOL*
 *captions are illuminated.  IF -           *
 *****************************************
            |    |
```

OK NOT OK------ | ISOL section of system BATT - FAIL/ ISOL caption remains extinguished - Chart 114. |

P. *Switch off and disconnect electrical ground power as detailed in 24-41-00.*

4. Trouble Shooting - Emergency Generation - Preliminary (Including Auto-shed Breaker)

A. *Prepare to Trouble Shoot (Ref. para.2.C.). Observe No.1 engine HP rpm (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, checking that the pointer on No.1 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2. IF -*

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK NOT OK------ | No.1 engine HP rpm (N2) indicator fails to provide a steady reading of approximately 65 per cent N2 - refer to Trouble Shooting of the LP(N1) and HP(N2) rpm Indication system (Ref. 71-00-36). |

B. *With the reading of No.1 engine HP rpm (N2) indicator at approximately 65 per cent N2, check that the emergency generator SELECTED and FAIL captions are extinguished, and the ASB position magnetic indicator changes from cross-line to in-line. IF -*

```
                 |      |
                 |      |        ----------------------------------
                 |      |       |1. SELECTED and FAIL captions     |
                OK    NOT OK----|   remain illuminated and ASB     |
                 |              |   position magnetic indicator    |
                 |              |   remains cross-line - check for |
                 |              |   28 V d.c. at terminal 2 of CB  |
                 |              |   (145). If present, *renew Engine|
                 |              |   Speed Unit (95); if not present,|
                 |              |   renew CB (145).                |
                 |              |2. ASB position magnetic indicator |
                 |              A   in-line but SELECTED and FAIL  |
                 |              |   captions remain illuminated -  |
                 |              |   - *renew Engine Speed Unit (95).|
                 |              |3. SELECTED and FAIL captions     |
                 |              |   illuminated but ASB position   |
                 |              |   indicator remains cross-line - |
                 |              |   Chart 115.                     |
                 |               ----------------------------------
                 |
C.*********************************************
  *Trip the ENG 1 MAIN THROT SUP circuit      *
  *breaker 1K1 on panel 2-213, map ref.F12,   *
  *and check that when the reading on No.1    *
  *engine HP rpm (N2) indicator falls below   *
  *approximately 58 per cent N2, the          *
  *emergency generator SELECTED and FAIL      *
  *captions are illuminated, and the ASB      *
  *position magnetic indicator changes from   *
  *in-line to cross-line. IF -                *
  *********************************************
                 |      |
                 |      |        ----------------------------------
                 |      |       |1. SELECTED and FAIL captions     |
                OK    NOT OK----|   remain extinguished and ASB    |
                 |              |   position magnetic indicator    |
                 |              |   remains in-line - renew Engine |
                 |              |   Speed Unit (95).               |
```


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2. ASB position magnetic indicator cross-line but SELECTED and FAIL captions remain illuminated - renew Engine Speed Unit (95).
3. SELECTED and FAIL captions extinguished but ASB position magnetic indicator remains in-line - trip CB (145) and check if indicator moves to cross-line. If YES, renew Engine Speed Unit (95); if NO, renew ASB Position Magnetic Indicator (101).

D. Fit a safety clip to the circuit breaker tripped in operation C. Disconnect the throttle system test set cable 2 connector from connector socket SKT 2 on No.1 engine main control amplifier and reconnect it to connector socket SKT 2 on the front of No.2 engine main control amplifier (2K20). Observe No.2 engine HP rpm (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP rpm (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2. IF -

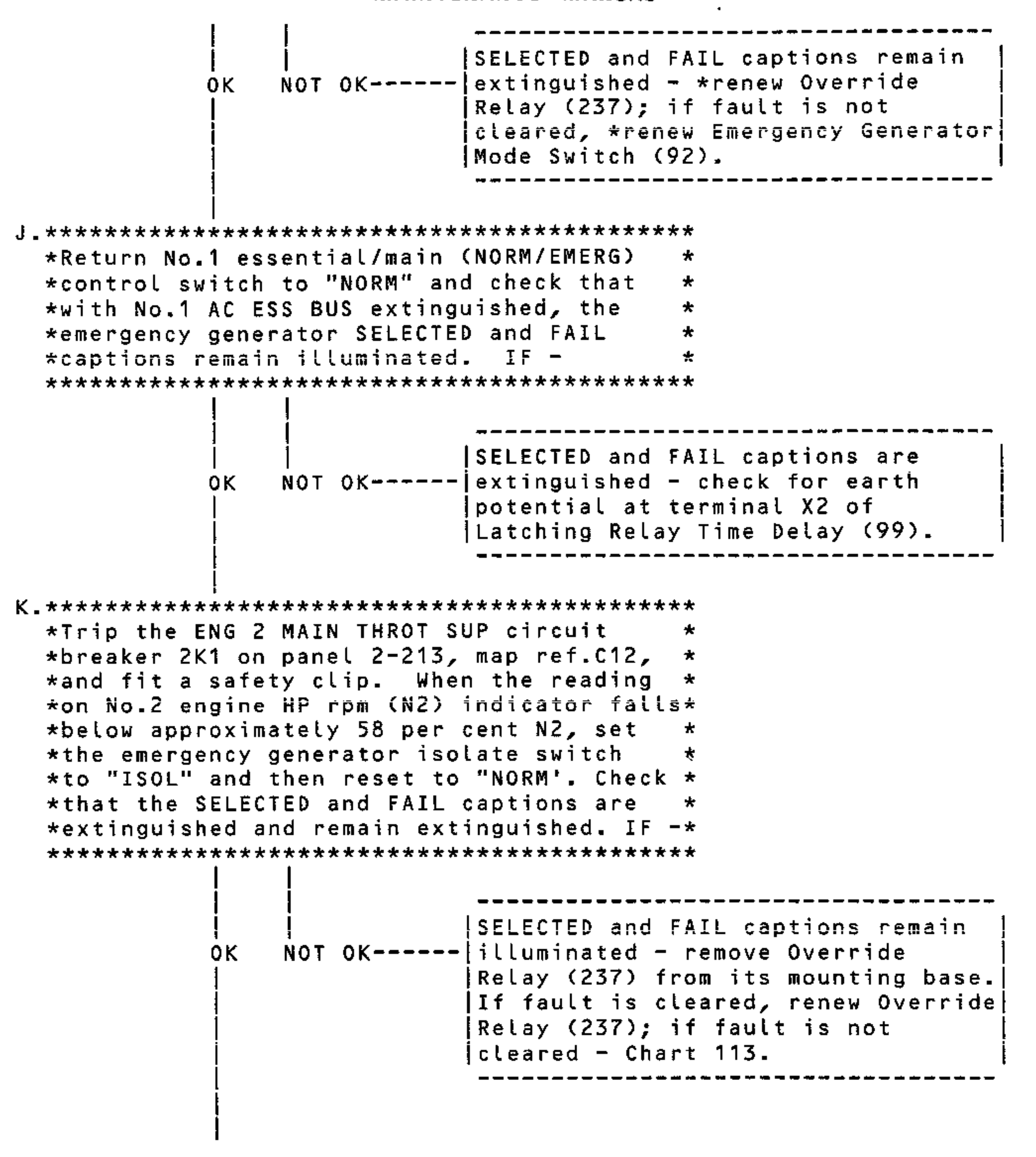
OK

NOT OK - No.2 engine HP rpm (N2) indicator fails to provide a steady reading of approximately 65 per cent N2 - refer to Trouble Shooting of the LP (N1) and HP (N2) rpm Indication system (Ref. 71-00-36).

```
                   |
E.********************************************
  *With the reading on No.2 engine HP rpm    *
  *(N2) indicator at approximately 65 per    *
  *cent N2, check that the emergency         *
  *generator SELECTED and FAIL captions are  *
  *extinguished, and the ASB position        *
  *magnetic indicator changes from cross-line*
  *to in-line.  IF-                          *
  ********************************************
                   |    |
                   |    |        -----------------------------------
                   |    |       |SELECTED and FAIL captions remain  |
                  OK   NOT OK------|illuminated and ASB position       |
                   |            |magnetic indicator remains in-line |
                   |            |- *renew Engine Speed Unit (95).   |
                   |             -----------------------------------
                   |
F.********************************************
  *Set, in turn, Nos.1, 2, 3 and 4 essential/*
  *main (NORM/EMERG) control switches to     *
  *"EMERG" and then return to "NORM". Check  *
  *that when any one switch is at EMERG the  *
  *associated essential/main isolate magnetic*
  *indicator displays cross-line, the        *
  *associated AC ESS BUS caption is illumi-  *
  *nated, and the emergency generator FAIL   *
  *and SELECTED captions are illuminated.    *
  *IF -                                      *
  ********************************************
                   |    |
                   |    |        -----------------------------------
                   |    |       |1. An essential/main isolate       |
                  OK   NOT OK------|   magnetic indicator remains in-  |
                   |            |   line with the associated essen- |
                   |            |   tial/main control switch set to |
                   |            |   EMERG - Chart 116.              |
                   |            |2. All indications remain unchanged|
                   |            |   when an essential/main control  |
                   |            |   switch is set to EMERG, or if   |
                   |            |   the AC ESS BUS, SELECTED and    |
                   |            |   FAIL captions remain illuminated|
                   |            |   when essential/main control     |
                   |            |   switch is returned to NORM -    |
                   |            |   renew Essential/Main Control    |
                   |            |   switch (50), (51), (52) or (53).|
                   |             -----------------------------------
                   |
```

```
                |
G.*********************************************
  *Trip the ENG 2 MAIN THROT SUP circuit      *
  *breaker 2K1 on panel 2-213, map ref.C12,   *
  *and check that when the reading on No.2    *
  *engine HP rpm (N2) indicator falls below   *
  *approximately 58 per cent N2 the           *
  *emergency generator SELECTED and FAIL      *
  *captions are illuminated, and the ASB      *
  *position magnetic indicator changes from   *
  *in-line to cross-line. IF -                *
  *********************************************
                |    |
                |    |                 ------------------------------------
                |    |                |SELECTED and FAIL captions remain  |
                OK   NOT OK-----------|extinguished and ASB position mag- |
                |                     |netic indicator remains in-line -  |
                |                     |renew Engine Speed Unit (95).      |
                |                      ------------------------------------

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H.*********************************************
  *Set the emergency generator isolate switch*
  *to "ISOL" and the mode switch to "AUTO",  *
  *then set the isolate switch to "NORM" and *
  *check that the emergency generator        *
  *SELECTED and FAIL captions are            *
  *extinguished.  IF -                       *
  *********************************************
                |    |
                |    |                 ------------------------------------
                OK   NOT OK-----------|SELECTED and FAIL captions remain  |
                |                     |illuminated - Chart 113.           |
                |                      ------------------------------------
                |
I.*********************************************
  *Observe No.2 engine HP rpm indicator on    *
  *the pilots' centre instrument panel 6-211.*
  *Reset the ENG 2 MAIN THROT SUP circuit     *
  *breaker 2K1 on panel 2-213, map ref.C12,   *
  *checking that the pointer on No.2 engine   *
  *HP rpm indicator moves up to and remains   *
  *at a dial reading of approximately 65      *
  *per cent N2. Set No.1 essential/main       *
  *(NORM/EMERG) control switch to "EMERG" and*
  *check that with No.1 AC ESS BUS caption    *
  *illuminated, the emergency generator       *
  *SELECTED and FAIL captions are             *
  *illuminated.  IF -                         *
  *********************************************
                |    |
```



```
          |     |             ---------------------------------------
          |     |            |SELECTED and FAIL captions remain     |
          OK    NOT OK------|extinguished - *renew Override        |
          |                  |Relay (237); if fault is not          |
          |                  |cleared, *renew Emergency Generator   |
          |                  |Mode Switch (92).                     |
          |                   ---------------------------------------
          |
J.*******************************************
  *Return No.1 essential/main (NORM/EMERG)   *
  *control switch to "NORM" and check that   *
  *with No.1 AC ESS BUS extinguished, the    *
  *emergency generator SELECTED and FAIL     *
  *captions remain illuminated.  IF -        *
  *******************************************
          |     |
          |     |             ---------------------------------------
          |     |            |SELECTED and FAIL captions are        |
          OK    NOT OK------|extinguished - check for earth        |
          |                  |potential at terminal X2 of           |
          |                  |Latching Relay Time Delay (99).       |
          |                   ---------------------------------------
          |
K.*******************************************
  *Trip the ENG 2 MAIN THROT SUP circuit     *
  *breaker 2K1 on panel 2-213, map ref.C12,  *
  *and fit a safety clip.  When the reading  *
  *on No.2 engine HP rpm (N2) indicator falls*
  *below approximately 58 per cent N2, set   *
  *the emergency generator isolate switch    *
  *to "ISOL" and then reset to "NORM'. Check *
  *that the SELECTED and FAIL captions are   *
  *extinguished and remain extinguished. IF -*
  *******************************************
          |     |
          |     |             ---------------------------------------
          |     |            |SELECTED and FAIL captions remain     |
          OK    NOT OK------|illuminated - remove Override         |
          |                  |Relay (237) from its mounting base.   |
          |                  |If fault is cleared, renew Override   |
          |                  |Relay (237); if fault is not          |
          |                  |cleared - Chart 113.                  |
          |                   ---------------------------------------
          |
          |
```

```
L.*********************************************
  *Trip the EMER GEN AUTO CONT circuit        *
  *breaker X212 (93), and fit a safety clip.  *
  *Disconnect the throttle control system     *
  *test set cable 2 connector from connector  *
  *socket SKT 2 on No.2 engine main control   *
  *amplifier and from connector socket PL 2   *
  *on the test set. Remove the test set, fit  *
  *the captive protection caps to connector   *
  *sockets SKT 2 on Nos.1 and 2 engine main   *
  *control amplifiers and refit the panels    *
  *removed to gain access to shelves 6-215    *
  *and 8-215.                                 *
  *Remove the safety clips and reset the      *
  *ENG 1 MAIN THROT SUP circuit breaker 1K1   *
  *on panel 2-213, map ref.F12, and the ENG 2*
  *MAIN THROT SUP circuit breaker 2K1 on      *
  *panel 2-213, map ref.C12. Remove the       *
  *warning placard (Ref. para.2.C.(7).        *
  *Refer to the CAUTION (Ref. para.2.C.);     *
  *then trip the LH UC WEIGHT SW & DOWNLOCK   *
  *'B' SYS SUP circuit breaker G293 on panel  *
  *3-213, map ref.B8, and the RH UC WEIGHT SW*
  *'B' SYS SUP circuit breaker G294 on panel  *
  *3-213, map ref.B9;  fit safety clips.  Set*
  *the emergency generator mode switch to     *
  *"AUTO".  Remove the safety clip from and   *
  *reset the EMER GEN AUTO CONT circuit       *
  *breaker X212 (93);  check that the         *
  *emergency generator SELECTED and FAIL      *
  *captions are illuminated.  IF -            *
  ********************************************
             |    |
             |    |                -----------------------------------
             |    |               |SELECTED and FAIL captions remain  |
             OK   NOT OK----------|extinguished - check for 28 V d.c. |
             |                    |at terminal 5 of TB UG2843 on shelf|
             |                    |12-215.  If present, *renew        |
             |                    |Emergency Generator Mode Switch    |
             |                    |(92);  if not present, check for   |
             |                    |O/C in wiring between terminal 4 of|
             |                    |TB UG2843 and pin 5 of Engine Speed|
             |                    |Unit (95).                         |
             |                     -----------------------------------
```

```
                  |
                  |
M.*******************************************
  *Reset CBs G293 on panel 3-213, map ref.B8,*
  *and G294 on panel 3-213, map ref.B9. Check*
  *that the emergency generator SELECTED and *
  *FAIL captions remain illuminated.  IF -   *
  ********************************************
                  |    |
                  |    |                ------------------------------------
                  |    |               |SELECTED and FAIL captions are      |
                 OK   NOT OK-----------|extinguished when both CBs G293 and|
                  |                    |G294 are reset - check for earth    |
                  |                    |potential at terminal X2 of Latch-  |
                  |                    |ing Relay (96).  If present, *renew|
                  |                    |Latching Relay (96); if not         |
                  |                    |present, renew Latching Relay Time  |
                  |                    |Delay (99).                         |
                  |                     ------------------------------------
                  |
                  |
N.********************************************
  *Set the emergency generator isolate switch*
  *to "ISOL" and then to "NORM" to extinguish*
  *the SELECTED and FAIL captions.  Ensure   *
  *that the weight switch relay controlled   *
  *services isolated in accordance with the  *
  *provisions of the CAUTION (Ref. para.2.C.)*
  *are reinstated as required.               *
  ********************************************
```

R **ON A/C 007-007,

5. Trouble Shooting - Emergency Generator Overheat Indication

A. *Prepare to trouble shoot (Ref. para.2.D.). Progressively increase the resistance on the resistance box connected between pins A and B. Check that the emergency generator O/HEAT caption and the master warning red ELEC caption are illuminated when the resistance setting is within the range 162 to 167 ohm. Reset the resistance box to 100 ohm and check that the O/HEAT caption and the master warning red ELEC caption are extinguished. IF -

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK

1. O/HEAT caption fails to become illuminated - press-to-test O/HEAT caption. If caption is then illuminated, *renew Temperature Controlled Relay (102). If caption remains extinguished, *renew Emergency Generator O/HEAT Caption Light Module (103).
2. O/HEAT caption is illuminated but the master warning red ELEC caption is not illuminated - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00).
3. O/HEAT caption fails to become extinguished when resistance is decreased - renew Temperature Controlled Relay (102).

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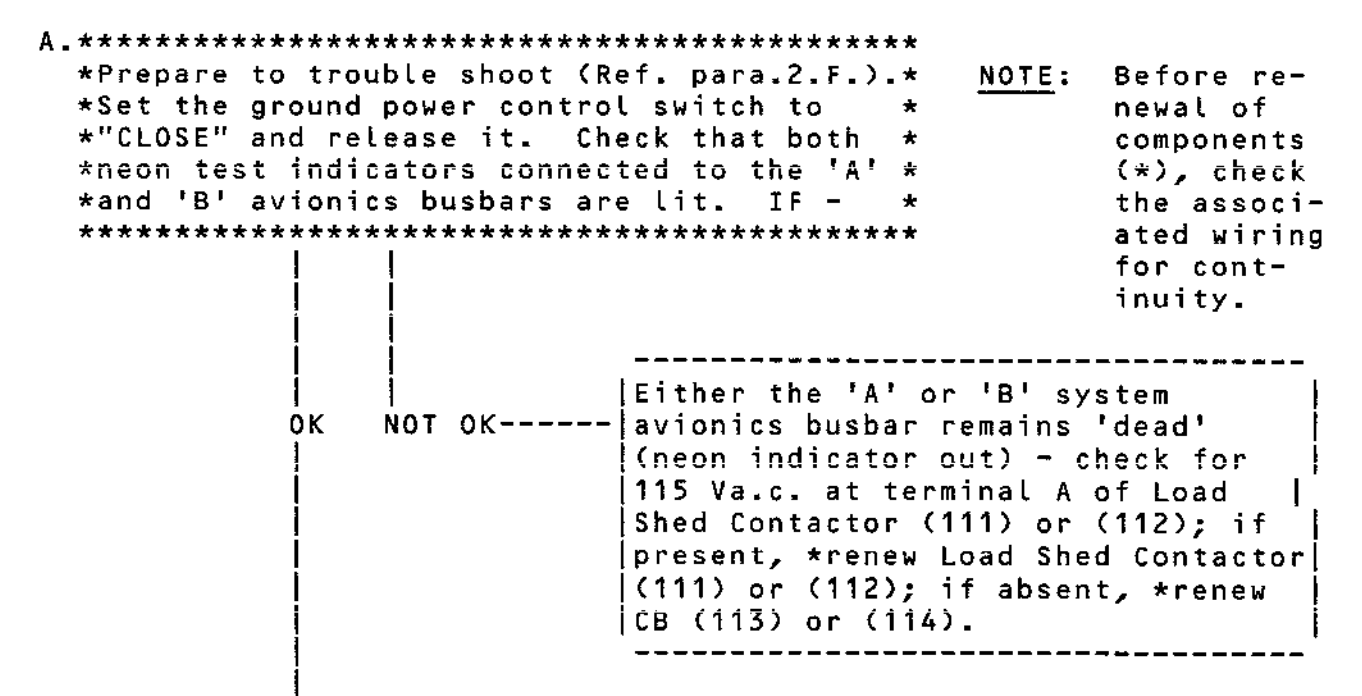
```
                  |
B.*********************************************
  *Progressively increase the resistance on   *
  *the resistance box connected between pins *
  *G and H.  Check that the O/HEAT caption    *
  *and the master warning red ELEC caption    *
  *are illuminated when the resistance        *
  *setting is within the range 162 to 167 ohm*
  *Reset the resistance box to 100 ohm and    *
  *check that the O/HEAT caption and the      *
  *master warning red ELEC caption are        *
  *extinguished.  IF -                        *
  *********************************************
                  |    |
                  |    |
                  |    |                -----------------------------------
                  |    |               |1. O/HEAT caption fails to become  |
                 OK   NOY OK-----------|   illuminated - *renew Temperature|
                  |                    |   Controlled Relay (104).         |
                  |                    |2. O/HEAT caption fails to become  |
                  |                    |   extinguished when resistance is |
                  |                    |   decreased - renew Temperature   |
                  |                    |   Controlled Relay (104).         |
                  |                     -----------------------------------
                  |
C.*********************************************
  *Extinguish the emergency generator         *
  *SELECTED and FAIL captions by setting the *
  *emergency generator mode switch to "AUTO" *
  *and the isolation switch to "ISOL"; return*
  *the isolation switch to "NORM", trip CB   *
  *(93) and fit a safety clip.  Disconnect   *
  *both decade resistance boxes and reconnect*
  *the electrical connector X200-A to the    *
  *emergency generator.  Refit the access    *
  *door removed in Preparation, remove the   *
  *safety clips and reset CB (93) and CB     *
  *(90).                                      *
  *********************************************
```

6. Trouble Shooting - 26 V 400 Hz AC Generation

```
A.*********************************************
  *Prepare to trouble shoot (Ref. para.2.E.).*
  *Set the ground power control switch to    *
  *"CLOSE" and release it.  Check that the   *
  *four test lamps connected to the 26 V a.c.*
  *busbars are lit.  IF -                    *
  ********************************************
             |     |
             |     |             -----------------------------------
             |     |            |1. Both 26 V a.c. 'A' main and     |
             OK    NOT OK-------|   essential busbars remain 'dead' |
             |                  |   (test lamps out) or both 26 V   |
             |                  |   a.c. 'B' main and essential bus-|
             |                  |   bars remain 'dead' - Chart 117. |
             |                  |2. Either the 26 V a.c. 'A' or 'B' |
             |                  |   main busbar remains 'dead' (test|
             |                  |   lamp out) - renew Load Shed     |
             |                  |   Contactor (107) or (108).       |
             |                  |3. Either the 26 V a.c. 'A' or 'B' |
             |                  |   essential busbar remains 'dead' |
             |                  |   (test lamp out) - locate and    |
             |                  |   rectify O/C between terminal A  |
             |                  |   of Load Shed Contactor (107) or |
             |                  |   (108) and terminal 1 on TB      |
             |                  |   (UG2737) or (UG2739) behind the |
             |                  |   circuit breaker panels in zone  |
             |                  |   213.                            |
             |                   -----------------------------------
             |
```

B. *Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG". Check that the test lamps connected to the 26 V a.c. 'A' and 'B' busbars go out.
Return Nos.2 and 3 essential/main (NORM/EMERG) control switches to "NORM". Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on. Trip and fit safety clips to CBs (105) and (106).
Disconnect and remove the four test lamps.
Close and secure the circuit breaker panels. Remove the safety clips and reset CBs (105) and (106). Remove the warning placard from the ground power rig.*

7. Trouble Shooting - 'A' and 'B' Avionics 115 V 400 Hz AC Busbars



A. *Prepare to trouble shoot (Ref. para.2.F.). Set the ground power control switch to "CLOSE" and release it. Check that both neon test indicators connected to the 'A' and 'B' avionics busbars are lit. IF -*

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK ------ Either the 'A' or 'B' system avionics busbar remains 'dead' (neon indicator out) - check for 115 Va.c. at terminal A of Load Shed Contactor (111) or (112); if present, *renew Load Shed Contactor (111) or (112); if absent, *renew CB (113) or (114).

```
                |
B.*******************************************
  *Set Nos.2 and 3 essential/main (NORM/     *
  *EMERG) control switches to "EMERG". Check *
  *that both neon test indicators go out.    *
  *IF -                                      *
  *******************************************
                |    |
                |    |                -----------------------------------
                |    |               |Either the 'A' or 'B' system      |
                OK   NOT OK------    |avionics busbar remains 'live'    |
                |                    |(neon indicator lit) - renew *Load|
                |                    |Shed Contactor (111) or (112).    |
                |                     -----------------------------------
                |
                |
C.*******************************************
  *Return Nos.2 and 3 essential/main (NORM/  *
  *EMERG) control switches to "NORM".  Switch*
  *off the ground power supply at source and *
  *place a warning placard on the ground     *
  *power rig forbidding any attempt to switch*
  *the ground power supply on.  Trip and fit *
  *safety clips to CBs (113)and (114).      *
  *Disconnect and remove the two neon test   *
  *indicators.  Close and secure the circuit *
  *breaker panels.  Remove the safety clips  *
  *and reset CBs (113) and (114).  Remove the*
  *warning placard from the ground power rig.*
  *******************************************
```

8. Trouble Shooting - 115/26 V AC Standby Inverter Supplies and Control

```
A.*******************************************
  *Prepare to trouble shoot (Ref. para.2.G.).*
  *Set the ground power control switch to    *
  *"CLOSE" and release it.  Check that the   *
  *26 V and 115 V busbars are 'live', by     *
  *observing the test lamp and the voltage   *
  *and frequency indications on the test=    *
  *meters (approx. 115 V 400 Hz). IF -       *
  *******************************************
                |    |
```

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK   NOT OK------

1. 26 V and 115 V a.c. standby busbars are 'dead', i.e., voltage and frequency not indicated on test meters and test lamp remains out - check for 115 V a.c. output at CB (115); if present, *renew Static Inverter Control relay (116); if not present, renew CB (115).
2. 26 V a.c. standby busbar is 'dead', i.e., test lamp remains out - check for 115 V a.c. output at CB (160); if present *renew 26 V a.c. transformer (119); if not present, *renew CB (160).

B. Set the ground power control switch to "TRIP" and release it; check that the indications on the test voltmeter and frequency meter fall to zero and the test lamp goes out. Trip, and fit a safety clip to, CB (115) to isolate the 115 V a.c. standby busbar from the No.1 essential busbar. Set the ground power control switch to "CLOSE" and check that the indications on the test voltmeter and frequency meter remain at zero and the test lamp remains out. IF -

OK   NOT OK------

26 V and 115 V a.c. standby busbars are 'live' i.e., voltage and frequency are indicated on the testmeters and the test lamp is lit - renew Static Inverter Control Relay (116). Check that fault has cleared. If not, renew Ram Air Turbine (RAT) Control Switches (117) or (118).

```
                  |
C.********************************************
  *WARNING:  THE CONTROL SWITCHES ON THE RAM *
  *          AIR TURBINE (RAT) CONTROL PANEL *
  *          ARE EACH GUARDED TO PERMIT OPER-*
  *          ATION OF A SWITCH TO THE "TEST" *
  *          POSITION ONLY, AS REQUIRED FOR  *
  *          THE FOLLOWING TEST.             *
  *                                          *
  *          THESE GUARDS MUST NOT BE RAISED,*
  *          SINCE OPERATION OF EITHER SWITCH*
  *          TO THE "ON" POSITION WILL       *
  *          INITIATE THE AUTOMATIC EXTENSION*
  *          OF THE RAM AIR TURBINE TO ITS   *
  *          OPERATIONAL POSITION BENEATH THE*
  *          AIRCRAFT.                       *
  *                                          *
  *Set left-hand ram air turbine (RAT control*
  *switch (panel 14-214) to "TEST" and hold  *
  *in position (TEST caption in panel (Ref.  *
  *Chap.29) will be illuminated).  Check that*
  *the 26 V and 115 V a.c. standby busbars   *
  *are 'live', by observing the test lamp and*
  *the indications on the test voltmeter and *
  *frequency meter. Check also that the volt-*
  *age and frequency of the static inverter  *
  *so indicated are correct, i.e.,           *
  *115(+5 -8.5) V 400(±8) Hz. IF -           *
  ********************************************
                  |    |
                  |    |         ----------------------------------
                  |    |        |1. 26 V and 115 V a.c. standby    |
                  OK   NOT OK------|   busbars remain 'dead', i.e.,    |
                  |             |   voltage and frequency not       |
                  |             |   indicated and test lamp remains|
                  |             |   out  - Chart 118.               |
                  |             |2. Voltage and/or frequency        |
                  |             |   indications are incorrect -     |
                  |             |   renew Static Inverter (121).    |
                  |              ----------------------------------
                  |
D.*******************************************
  *Release switch (TEST caption (Ref. Chap. *
  *29) will be extinguished). Check that the*
  *indications on the test voltmeter and    *
  *frequency meter fall to zero and the test*
  *lamp goes out.  IF -                     *
  *******************************************
                  |    |
```

OK — NOT OK: 26 V and 115 V a.c. standby busbars remain 'live', i.e., voltage and frequency are indicated on the testmeters and the test lamp is lit - renew Ram Air Turbine (RAT) Control switch (117)

E. Set the right-hand RAT control switch to the "TEST" position and hold it (TEST caption (Ref. Chap.29) will be illuminated). Check that the 26 V and 115 V a.c. standby busbars are 'live', by observing the test lamp and the indications on the test voltmeter and frequency meter. IF -

OK — NOT OK: Voltage and frequency not indicated and test lamp remains out - *renew Ram Air Turbine (RAT) Control Switch (118).

F. Release switch (TEST caption (Ref. Chap. 29) will be extinguished). Check that the indications on the test voltmeter and frequency meter fall to zero and the test lamp goes out. IF -

OK — NOT OK: 26 V and 115 V a.c. standby busbars remain 'live' i.e., voltage and frequency are indicated on the testmeters and the test lamp is lit - renew Ram Air Turbine (RAT) Control Switch (118).

```
                |
G.********************************************
  *Switch off the ground power supply at     *
  *source and place a warning placard on the *
  *ground power rig forbidding any attempt to*
  *switch the ground power on.  Disconnect   *
  *and remove the test voltmeter and         *
  *frequency meter and the test lamp. Close  *
  *and secure circuit breaker panel 2-213.   *
  *Remove the safety clip and reset CB (115).*
  *Remove the warning placard from the ground*
  *power rig.                                *
  ********************************************
```

9. Trouble Shooting - DC Essential/Main Split - AC Undervolt Control

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
A.********************************************
  *Prepare to trouble shoot (Ref. para.2.H.).*
  *Set No.1 BTB control switch to "NORM" and *
  *then back to "TRIP".  Check that both 'A' *
  *and 'B' system essential/main split       *
  *magnetic indicators change from cross-line*
  *to in-line, and then back to cross-line.  *
  *IF -                                      *
  ********************************************
                |    |
                |    |        -----------------------------------
                |    |       |1. Both essential/main split       |
                OK   NOT OK--|   magnetic indicators remain      |
                |            |   cross-line - *renew No.1 Main AC|
                |            |   Undervolt Unit (21).            |
                |            |2. 'A' system essential main split |
                |            |   magnetic indicator remains      |
                |            |   cross-line.  Check and renew as |
                |            |   necessary Fuses (126) and/or    |
                |            |   (127).                          |
                |             -----------------------------------
```

```
                 |
                 |
B.*********************************************
  *Set Nos.2 and 4 BTB control switches, in   *
  *turn, to "NORM" and then back to "TRIP".   *
  *Check that both 'A' and 'B' system         *
  *essential/main split magnetic indicators   *
  *change from cross-line to in-line, and     *
  *then back to cross-line with the operation*
  *of each switch.  IF -                      *
  *********************************************
                 |    |
                 |    |                 ------------------------------------
                 |    |                |Both essential/main split magnetic |
                 OK   NOT OK------|indicators remain cross-line -      |
                 |                     |renew Main AC Undervolt Unit (22)  |
                 |                     |or (24).                           |
                 |                      ------------------------------------
                 |
```

```
            |
C.********************************************
  *Set BATT A and BATT B control switches to *
  *"OFF"; ensure associated magnetic         *
  *indicators display cross-line.  Switch off*
  *ground power at source and place a warning*
  *placard on the ground power rig forbidding*
  *any attempt to switch the ground power    *
  *supply 'on'.  Gain access to No.3 Main AC *
  *Undervolt Unit (23). Remove the terminal  *
  *cover and reconnect the earth cable to    *
  *terminal 4 (earth) of the Unit (23),      *
  *checking the order of the terminal        *
  *screw washers. Torque-tighten the terminal*
  *screw to between 12 and 14 lbf in (0.137  *
  *and 0.160 mdaN). Refit the terminal cover.*
  *Close and secure the circuit breaker      *
  *panel. Remove the warning placard, switch *
  *on ground power at source and set the     *
  *ground power control switch to "CLOSE"    *
  *and release it.  Set BATT A and BATT B    *
  *control switches to "ON". Ensure          *
  *that Nos.1, 2 and 4 BTB control switches  *
  *are at TRIP, No.3 BTB control switch is at*
  *NORM and that No.3 AC MAIN BUS and AC ESS *
  *BUS captions are extinguished.  Check that*
  *both 'A' and 'B' essential/main split     *
  *magnetic indicators display in-line.  IF -*
  ********************************************
            |    |
            |    |                 ------------------------------------
            |    |                |Both essential/main split magnetic |
            OK   NOT OK-----------|indicators remain cross-line -     |
            |                     |renew Main AC Undervolt Unit (23). |
            |                      ------------------------------------
            |
D.********************************************
  *Set Nos.1, 2 and 4 BTB control switches to*
  *"NORM", the DC VOLTS selector switch to   *
  *"MAIN A" or "MAIN B" and the four TRU     *
  *control switches to "ISOL", in turn. Check*
  *that the DC MAIN BUS caption is illumi=   *
  *nated and both 'A' and 'B' essential/main *
  *split magnetic indicators display cross-  *
  *line when the d.c. voltage falls below    *
  *25 V.  IF -                               *
  ********************************************
            |    |
```

```
        |     |
        |     |          -----------------------------------
        |     |         |1. The 'A' system essential/main   |
        OK    NOT OK----|   split magnetic indicator        |
        |               |   displays in-line when the d.c.  |
        |               |   voltage falls below 25 V - renew|
        |               |   'A' System Main DC Undervolt     |
        |               |   Unit (124).                     |
        |               |2. The 'B' system essential/main   |
        |               |   split magnetic indicator        |
        |               |   displays in-line when the d.c.  |
        |               |   voltage falls below 25 V - renew|
        |               |   'B' System Main DC Undervolt    |
        |               |   Unit (125).                     |
        |                -----------------------------------
        |
E.********************************************
  *Return all four TRU control switches to   *
  *"NORM".  Set BATT A and BATT B control    *
  *switches to "OFF".                        *
  ********************************************
```

10. Trouble Shooting - Battery Charge Control

```
A.*******************************************
  *Prepare to trouble shoot (Ref. para.2.I.) *
  *NOTE: The following procedures require    *
  *      operation of the test button on     *
  *      each battery charge controller      *
  *      (1P35) and (2P35) and observation   *
  *      of the resulting indications on the*
  *      controllers and the BATT - FAIL/    *
  *      ISOL captions on the electrical     *
  *      generating control panel.           *
  *Apply the following test operations, in  *
  *turn, to each battery charge controller - *
  *(a) Press and hold depressed, the test    *
  *    button. Check that after a period of *
  *    not less than 3 s or more than 6 s,   *
  *    the FAIL section of the associated    *
  *    BATT-FAIL/ISOL caption is illuminated *
  *    and that after a period of not less   *
  *    than 8 s or more than 12 s, the light-*
  *    emitting diode on the controller is   *
  *    illuminated.                          *
  *(b) Release the test button on the        *
  *    controller and check that the FAIL    *
  *    section of the associated BATT-FAIL/  *
  *    ISOL caption and the light-emitting   *
  *    diode are extinguished. IF -          *
  *******************************************
                  |    |
```

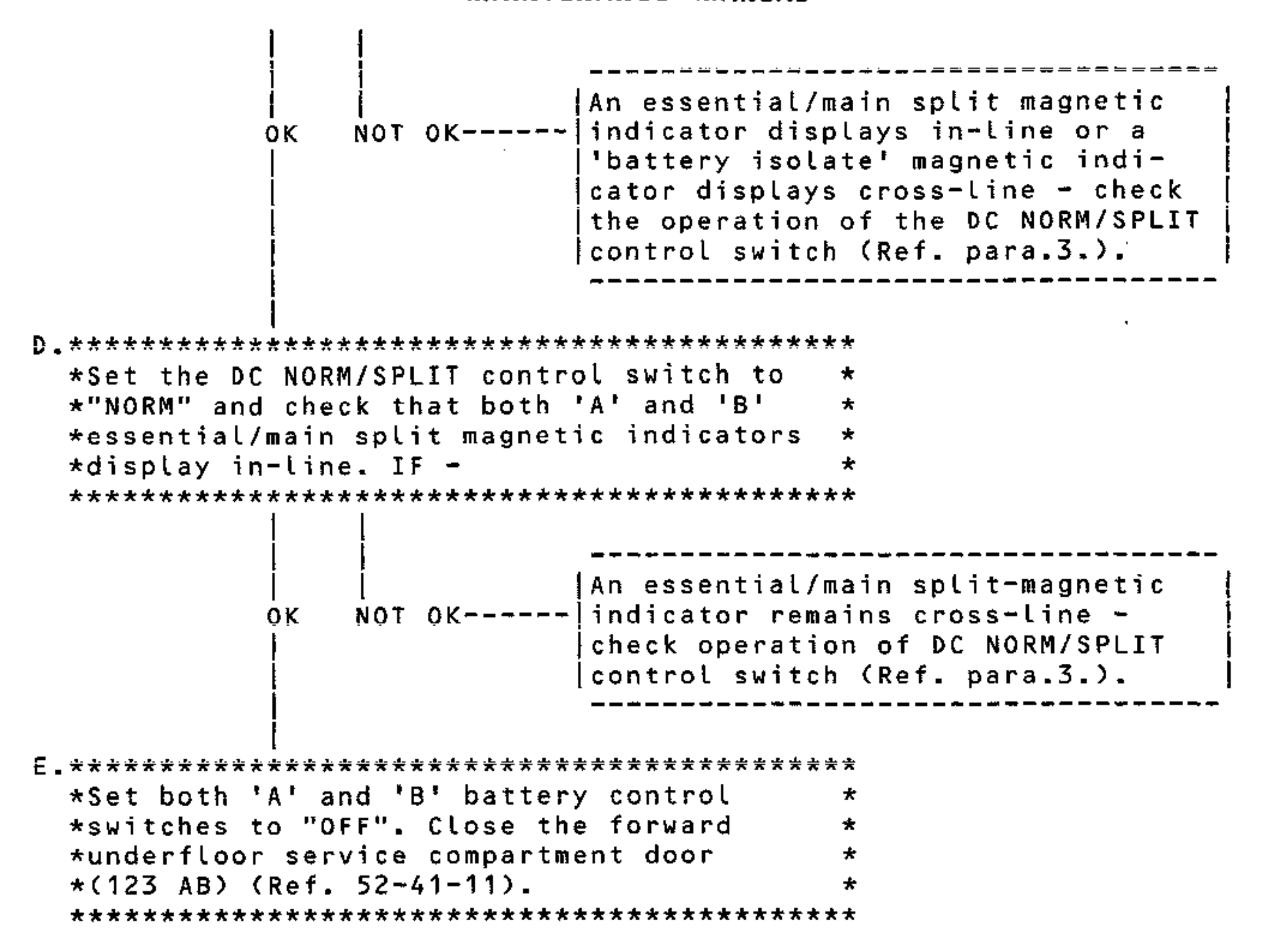
NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK

1. When the test button is depressed the FAIL section of the BATT-FAIL/ISOL caption is illuminated and the light-emitting diode is illuminated, but the signal time limits are not satisfied - renew Battery Charge Controller (235) or (236).
2. When the test button is depressed, the light-emitting diode is illuminated within the signal time limit but the FAIL section of the associated BATT-FAIL/ISOL caption is not illuminated - press-to-test the caption. If caption is not illuminated. *renew BATT-FAIL/ISOL Caption (3) or (4). If caption is illuminated, transpose Battery Charge Controllers (235) and (236). If fault is cleared, renew Battery Charge Controller (235) or (236); if fault is not cleared, *renew Battery Control Switch (9) or (10).
3. When the test button is depressed, the light-emitting diode is not illuminated - transpose Battery Charge Controllers (235) and (236). If fault is cleared, renew Battery Charge Controller (235) or (236); if fault is not cleared; *renew Battery Control Switch (9) or (10).
4. When the test button is released the light-emitting diode and/or the FAIL section of the associated BATT-FAIL/ISOL caption remain illuminated - renew Battery Charge Controller (235) or (236).

```
                |
B.*********************************************
  *Set the 'A' and 'B' battery control        *
  *switches to "ON". Check that the ISOL      *
  *section of the associated BATT - FAIL/ISOL*
  *caption is extinguished, the FAIL section *
  *remains extinguished, and the associated  *
  *'battery isolate' magnetic indicator      *
  *displays in-line. IF -                    *
  *********************************************
                |    |
                |    |          ---------------------------------
                |    |         |The ISOL section of the associated |
               OK   NOT OK------|(A or B) BATT - FAIL/ISOL caption |
                |               |remains illuminated and/or the    |
                |               |associated (A or B) 'battery      |
                |               |isolate magnetic indicator remains |
                |               |cross-line - check the operation of|
                |               |the 'A' or 'B' battery control    |
                |               |switch (Ref. para.3.).            |
                |                ---------------------------------
                |
C.*********************************************
  *Set the 'A' and 'B' battery control        *
  *switches to "NORM". Check that the ISOL    *
  *and FAIL sections of the associated BATT -*
  *FAIL/ISOL captions remain extinguished and*
  *the associated 'battery isolate' magnetic *
  *indicators remain in-line.                 *
  *NOTE: Battery charge control is auto-     *
  *      matic with the battery control       *
  *      switch at NORM. Thus, with a fully   *
  *      charged battery installed, the       *
  *      'battery isolate' magnetic indi-     *
  *      cator will change to cross-line      *
  *      if the battery control switch is     *
  *      left at NORM for longer than 5 min.*
  *Set the DC NORM/SPLIT control switch to   *
  *"SPLIT". Check that both 'A' and 'B'       *
  *essential/main split magnetic indicators  *
  *display cross-line and that both 'A' and  *
  *'B' 'battery isolate' magnetic indicators *
  *remain in-line. IF -                       *
  *********************************************
                |    |
```



```
                |     |
                |     |          ------------------------------------
                |     |         |An essential/main split magnetic    |
                OK    NOT OK----|indicator displays in-line or a     |
                |               |'battery isolate' magnetic indi-    |
                |               |cator displays cross-line - check   |
                |               |the operation of the DC NORM/SPLIT  |
                |               |control switch (Ref. para.3.).      |
                |                ------------------------------------
                |
D.*******************************************
  *Set the DC NORM/SPLIT control switch to   *
  *"NORM" and check that both 'A' and 'B'    *
  *essential/main split magnetic indicators  *
  *display in-line. IF -                     *
  *******************************************
                |     |
                |     |          ------------------------------------
                |     |         |An essential/main split-magnetic    |
                OK    NOT OK----|indicator remains cross-line -      |
                |               |check operation of DC NORM/SPLIT    |
                |               |control switch (Ref. para.3.).      |
                |                ------------------------------------
                |
E.*******************************************
  *Set both 'A' and 'B' battery control      *
  *switches to "OFF". Close the forward      *
  *underfloor service compartment door       *
  *(123 AB) (Ref. 52-41-11).                 *
  *******************************************
```

11. Trouble Shooting - Main Generation Dormant Circuits

```
A.********************************************
  *Prepare to trouble shoot (Ref. para.2.J.).*
  *Ensure that operation of the SSBs, BTBs,  *
  *and associated controls and indicators has*
  *been checked and cleared in accordance    *
  *with the procedures detailed in paragraph *
  *3. Preliminary.                           *
  *Carry out the applicable operations       *
  *detailed in Adjustment/Test, Table 501, as*
  *applied to No.1 channel.  IF -            *
  *                                          *
  *NOTE:  Switch numbers prefixed 'S' are    *
  *       test set switches.  On the set,    *
  *       switch S1 is identified only by the*
  *       number of engraved positions, i.e.,*
  *       positions 1 - 20; switches S2 to S7*
  *       are identified by corresponding    *
  *       engravings, i.e., SW2 to SW7.  The *
  *       VOLTS readings are those registered*
  *       on the test set voltmeter.         *
  ********************************************
             |    |
             |    |     ------------------------------------
             |    |    |1. Adjustment/Test operation 2.(1).|
            OK   NOT OK------|   With dormant circuit test set     |
             |          |   switch S1 set to position '7'   |
             |          |   and the GCB control switch set  |
             |          |   to ON, the associated GCB       |
             |          |   position magnetic indicator     |
             |          |   remains cross-line - Chart 119. |
             |          |2. Any other particular test       |
             |          |   results in a failure condition  |
             |          |   being given - renew No.1 Control|
             |          |   and Protection Unit (128).      |
             |           ------------------------------------
             |
B.********************************************
  *Disconnect the test set from No.1 CPU and *
  *repeat test as applied to Nos.2, 3 and 4  *
  *CPUs, in turn.  IF -                      *
  ********************************************
             |    |
```

OK — NOT OK:

1. Adjustment/Test operation 2.(1). With dormant circuit test set switch S1 set to position '7' and the GCB control switch set to ON, the associated GCB position magnetic indicator remains cross-line - Chart 119.
2. Any other particular test results in a failure condition being given - renew Control and Protection Unit (129), (130) or (131).

OK:

C. *Disconnect test set and remove from aircraft. Refit the panels removed for access to the CPUs and remove the warning placard from the electrical generating control panel (Ref. Preparation, paragraph 2.J.).*

12. Trouble Shooting - Emergency Generation - Using Hydraulic Ground Power

NOTE: Before renewal of components (*), check the associated wiring for continuity.

A. *Prepare to trouble shoot (Ref. para.2.K.).*
Check that Nos.1, 2, 3 and 4 engine relight busbars 'power on' neon indicator lamps are lit and the emergency generator 'power on' neon indicator lamp is extinguished. IF -

- OK — go to B.
- NOT OK — An engine relight busbar 'power on' neon indicator lamp remains out - Chart 120.

B. *Check that Nos.1, 2, 3 and 4 a.c. essential busbar 'power on' neon indicator lamps are lit. IF -*

- OK
- NOT OK —
  1. An essential busbar neon indicator lamp remains out with associated AC ESS BUS caption extinguished - renew Neon Indicator Lamp (132), (133), (134) or (135).
  2. An essential busbar neon indicator lamp out with associated ACESS BUS caption illuminated - check a.c. essential busbar 115/200 V supplies; if correct, check for 115 V a.c. output at CB (136),(137), (138) or (139); renew CB or rectify O/C as necessary.

C. *Set the AC FREQ/VOLTS selector switch to "EMERG PWR". Set Nos.1,2,3 and 4 essential/main (NORM/EMERG) control switches to "EMERG" (Nos.1,2,3 and 4 AC ESS BUS captions will be illuminated). Set the emergency generator mode switch to "MANUAL". Check that the emergency generator commences running, by observing the voltage and frequency indications on the associated meters (approx. 115 V 400 Hz) and the emergency generator 'power on' neon indicator. Check also that Nos.1 and 2 AC ESS BUS captions are extinguished, Nos.3 and 4 AC ESS BUS captions remain illuminated, the emergency generator voltage and frequency indications are not fluctuating, and an emergency generator load is indicated on the emergency generator KVA meter. IF -*

OK

NOT OK

NOTE: The associated checks on the initial application of electrical ground power prove the serviceability of of the voltmeter and frequency meter (Ref. 24-41-00).

1. Voltage and frequency not indicated, neon indicator lamp out; if emergency generator FAIL and SELECTED captions are also out - Chart 111.
2. Voltage and frequency not indicated, neon indicator lamp lit, if emergency generator FAIL caption is out and the SELECTED caption is illuminated - *renew AC FREQ/VOLTS Selector Switch (161); if fault not cleared, renew CB (159).

3. Voltage and frequency not indicated, neon indicator lamp out; if emergency generator FAIL and SELECTED captions are illuminated - Chart 121.
4. Voltage and frequency indicated neon indicator lamp out - renew Neon Indicator Lamp (144).
5. Voltage and frequency displayed and neon indicator lamp is lit with the emergency generator FAIL caption illuminated - check that frequency on frequency meter is between 390 and 410 Hz; if YES, renew Emergency Generator Control and Protection Unit (88); if NO, renew Emergency Generator and Drive Unit (162).
6. No load indication on emergency generator KVA meter with all other indications correct - *renew Emergency Generator KVA Meter (49). Check if fault is cleared. If fault not cleared, renew Emergency Generator KVA Meter Current Transformer (227).
7. No.1 or No.2 AC ESS BUS caption is illuminated with all other indications correct - *renew Essential/Main Change-over Contactor (54) or (55).
8. Nos.3 and 4 AC ESS BUS captions are extinguished - renew ASB (100).
9. Emergency generator voltage and/or frequency indications are fluctuating - renew Emergency Generator and Drive Unit (162).

```
D.*********************************************
  *Set Nos.1,2,3 and 4 essential/main (NORM/ *
  *EMERG) control switches to "NORM" (Nos.1, *
  *2,3 and 4 AC ESS BUS captions will be     *
  *extinguished).                            *
  *NOTE:  The following procedures require   *
  *       operation of the switches SW1, SW2,*
  *       SW3, SW5 (probe-operated) and SW4  *
  *       (push-button) on the emergency     *
  *       generator, control and protection  *
  *       unit (CPU) and observation of the  *
  *       resulting indications on the CPU   *
  *       and the emergency generator indi-  *
  *       cators on the electrical generating*
  *       control panel.                     *
  *Test the overvoltage (OV) generator trip  *
  *function as follows:-                     *
  *Press CPU switches SW4 and SW2, both      *
  *together, hold both depressed for a       *
  *period of not less than 1.5 s, and then   *
  *release both switches. Check that the     *
  *emergency generator is de-excited, i.e.,  *
  *the voltage and frequency indications fall*
  *to zero, the FAIL caption is illuminated, *
  *and the overvoltage fault indicator on the*
  *CPU displays OV.  IF -                    *
  *******************************************
             |    |
             |    |
             |    |         |1. Emergency generator fails to
            OK   NOT OK-----|   de-excite, i.e., voltage and
             |              |   frequency indications unchanged
             |              |   and FAIL caption not illuminated
             |              |   - renew Emergency Generator
             |              |   Control and Protection Unit
             |              |   (88).
             |              |2. Emergency generator is de-
             |              |   excited but overvoltage fault
             |              |   indicator on CPU does not
             |              |   display OV - renew Emergency
             |              |   Generator Control and Protection
             |              |   Unit (88).
             |
```

```
       |
E.*******************************************
  *Press-to-test the emergency generator    *
  *FAIL caption to reset the generator for  *
  *normal operation.  Check that the FAIL   *
  *caption is extinguished and the output of *
  *the emergency generator is reinstated,   *
  *by observing that the voltage and        *
  *frequency indications are correct        *
  *(approx. 115 V 400 Hz).  IF -            *
  *******************************************
       |    |
       |    |     -----------------------------------
       |    |    |Emergency generator voltage and    |
       OK   NOT OK------|frequency indications remain at    |
       |         |zero and FAIL caption is illumi-   |
       |         |nated - remove Emergency Generator |
       |         |Control and Protection Unit (88);  |
       |         |then reset CB (93) (tripped for CPU|
       |         |removal), press the FAIL caption   |
       |         |and check for 28 V d.c. output at  |
       |         |pin 12 of CPU rack connector       |
       |         |X201-A; if present, renew Emergency|
       |         |Generator Control and Protection   |
       |         |Unit (88); if absent, refit        |
       |         |Emergency Generator Control and    |
       |         |Protection Unit (88). Check for    |
       |         |28 V d.c. output at terminal 2 of  |
       |         |Diode (231); if absent, *renew     |
       |         |Diode (231); if present, *renew    |
       |         |FAIL Caption Light Module (87).    |
       |          -----------------------------------
       |
F.*******************************************
  *Press and then release the overvoltage   *
  *fault indicator reset switch SW1 on the  *
  *CPU and check that the OV display        *
  *disappears. IF -                         *
  *******************************************
       |    |
       |    |     ----------------------------------
       |    |    |OV display remains - renew        |
       OK   NOT OK------|Emergency Generator Control      |
       |         |and Protection Unit (88).         |
       |          ----------------------------------
       |
```

G. Test the differential protection (DP) trip function as follows:- Press CPU switches SW4 and SW3 both together; then release both switches without delay. Check that the emergency generator is de-excited, i.e., the voltage and frequency indications fall to zero, the FAIL caption is illuminated, and the differential protection fault indicator on the CPU displays DP. IF -

OK

NOT OK:

1. Emergency generator fails to de-excite, i.e., voltage and frequency indications unchanged and FAIL caption not illuminated - renew Emergency Generator Control and Protection Unit (88).
2. Emergency generator is de-excited but differential protection fault indicator on CPU does not display DP - renew Emergency Generator Control and Protection Unit (88).

H. Press-to-test the emergency generator FAIL caption to reset the generator for normal operation. Check that the FAIL caption is extinguished and the output of the emergency generator is reinstated, by observing that the voltage and frequency indications are correct (approx. 115 V 400 Hz). IF -

OK

NOT OK: Emergency generator voltage and frequency indications remain at zero and FAIL caption is illuminated - renew Emergency Generator Control and Protection Unit (88).

```
                  |
I.*********************************************
  *Press and then release the differential   *
  *protection fault indicator reset switch   *
  *SW5 on the CPU and check that the DP      *
  *display disappears. IF -                  *
  *********************************************
                  |    |
                  |    |     ------------------------------------
                  |    |    |DP display remains - renew          |
                  OK   NOT OK------|Emergency Generator Control and |
                  |                |Protection Unit (88).            |
                  |          ------------------------------------
                  |
J.*********************************************
  *Trip and fit safety clips to CBs (140),   *
  *(141),(142) and (143) (Nos.1, 2, 3 and 4  *
  *engine relight 'power on' neon indicator  *
  *lamps will be extinguished).  Select      *
  *positions "2", "4", "3" amd "1", in turn, *
  *at the EMERG RELIGHT BUSBAR selector      *
  *switch.  Check that at each position, the *
  *associated engine relight busbar 'power   *
  *on' neon indicator lamp is lit.  IF -     *
  *********************************************
                  |    |
                  |    |     ------------------------------------
                  |    |    |1. Nos.2 and 3 'power on' neon      |
                  OK   NOT OK------|   indicator lamps remain out -    |
                  |                |   check for 115 V a.c. output at  |
                  |                |   CB (158).  If present, renew CB |
                  |                |   (145); if absent, renew CB      |
                  |                |   (158).                          |
                  |                |2. Nos.1 and 4 'power on' neon     |
                  |                |   indicator lamps remain out -    |
                  |                |   check for 115 V a.c. output at  |
                  |                |   CB (157);  if present, renew CB |
                  |                |   (146); if absent, renew CB      |
                  |                |   (157).                          |
                  |                |3. One 'power on' neon indicator   |
                  |                |   lamp remains out - check for 28 |
                  |                |   28 V d.c. at terminal X1 of     |
                  |                |   associated Relight Change-over  |
                  |                |   Contactor (147), (148), (149)   |
                  |                |   or (150).  If present, *renew   |
                  |                |   relight change-over contactor;  |
                  |                |   if absent, *renew EMERG RELIGHT |
                  |                |   BUSBAR Selector Switch (151).   |
                  |          ------------------------------------
                  |
```

```
              |
K.*********************************************
  *Set the EMERG RELIGHT BUSBAR selector      *
  *switch to "OFF".  Check that all four      *
  *engine relight 'power on' neon indicator   *
  *lamps are out.  IF -                       *
  *********************************************
              |    |
              |    |     ------------------------------------
              |    |    |An engine relight 'power on' neon  |
              OK   NOT OK------|indicator lamp remains lit - renew |
              |         |Relight Change-over Contactor (147)|
              |         |(148), (149) or (150).             |
              |          ------------------------------------
              |
L.*********************************************
  *Set the emergency generator isolate switch*
  *to "ISOL".  Check that the emergency       *
  *generator ceases to run, by observing that*
  *the voltage and frequency indications fall*
  *to zero.  IF-                             *
  *********************************************
              |    |
              |    |     ------------------------------------
              |    |    |Emergency generator continues to   |
              OK   NOT OK======|run - renew Hydraulic Selector     |
              |         |Valve (152).                       |
              |          ------------------------------------
              |
M.*********************************************
  *Set the emergency generator mode switch to*
  *"AUTO" and the isolate switch to "NORM".  *
  *Remove the safety clips and reset CBs     *
  *(140), (141), (142) and (143);  check that*
  *all four engine relight busbar 'power on' *
  *neon indicator lamps light.  Switch off   *
  *and disconnect the ground hydraulic supply*
  *(Ref. Chap.29).  Switch off the ground    *
  *power supply at source.  Close and secure *
  *circuit breaker panels 1-213, 3-213 and   *
  *4-213. Fit the rear vestibule LH          *
  *electronic racking forward and decor     *
  *bulkheads (Ref. 25-71-00).                *
  *********************************************
```

R **ON A/C 007-007,

13. Trouble Shooting - AC and DC Generation Master Warning

A.***
Prepare to trouble shoot (Ref. para.2.L.).
*Apply the following master warning (M/W) *
*test procedures to each caption, NO.1 AC *
*MAIN BUS, NO.2 AC MAIN BUS, NO.3 AC MAIN *
*BUS, NO.4 AC MAIN BUS, DC MAIN BUS, 'A' *
BATT - FAIL/ISOL, and 'B' BATT - FAIL/ISOL
*in turn:- *
*(a) Press the face of the caption and *
* check that the caption (the FAIL *
* section only of A BATT - FAIL/ISOL *
* caption) is illuminated, and the amber*
* ELEC caption on the M/W display panel *
* is illuminated and the audio warning *
* (single-stroke gong) sounds. *
*(b) Release the face of the caption and *
* check that the caption is extinguished*
* and the amber ELEC caption on the M/W *
* display panel is extinguished. IF- *
****

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK

1. When an AC MAIN BUS, DC MAIN BUS or BATT - FAIL/ISOL caption is pressed, the caption (the FAIL section of a BATT - FAIL/ISOL caption) is not illuminated, the M/W amber ELEC caption is not illuminated and no audio warning is given - check for 28 V d.c. output at the associated supply CB; (25), (26), (27) or (28) for AC MAIN BUS captions; (77) for DC MAIN BUS caption; (84) or (85) for BATT - FAIL/ISOL captions. If absent, renew Circuit Breaker (25), (26), (27), (28), (77), (84) or (85). If present, *renew AC MAIN BUS Caption Light Module (17), (18), (19) or (20) or DC MAIN BUS Caption Light Module (76) or BATT - FAIL/ISOL Caption Light Module (3) or (4).
2. When an AC MAIN BUS, DC MAIN BUS or BATT - FAIL/ISOL caption is pressed, the caption (the FAIL section of a BATT - FAIL/ISOL caption) is illuminated, but the M/W amber ELEC caption is not illuminated and/ or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).
3. When released after satisfactory operation, an AC MAIN BUS, DC MAIN BUS or BATT - FAIL/ISOL (FAIL section) caption remains illuminated - renew AC MAIN BUS Caption Light Module (17), (18), (19) or (20) or DC MAIN BUS Caption Light Module (76) or BATT - FAIL/ISOL Caption Light Module (3) or (4).

B. *Apply the following test procedures to Nos.1, 2, 3 and 4 bus-tie breaker (BTB) control switches, in turn -

(a) Set the BTB control switch to "TRIP". Check that the associated AC MAIN BUS and AC ESS BUS captions are illuminated, the amber ELEC and red ELEC captions on the M/W display panel are illuminated and the audio warning (single-stroke gong) sounds.

(b) Return the BTB control switch to "NORM". Check that the associated AC MAIN BUS and AC ESS BUS captions are extinguished and the amber ELEC and red ELEC captions on the M/W display panel are extinguished. IF -

OK

NOT OK:

1. With BTB control switch at TRIP, the associated AC MAIN BUS and/or AC ESS BUS caption(s) remain(s) extinguished - check the operation of the BTB control switch and associated indicators within Preliminary (Ref. para.3.).
2. With BTB control switch at TRIP, the associated AC MAIN BUS and AC ESS BUS captions are illuminated but the M/W amber ELEC and/or red ELEC captions are not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).

3. With BTB control switch returned to NORM, the associated AC MAIN, BUS and/or AC ESS BUS captions remain illuminated (the M/W amber ELEC and/or red ELEC caption remains illuminated) - check the operation of the BTB control switch and associated indicators within Preliminary (Ref. para.3.).

C. Trip the 'A' SYS MAIN U/VOLT UNIT SUP circuit breaker 1P13 on panel 15-215, map ref.A2. Check that the DC MAIN BUS caption is illuminated and the audio warning (single-stroke gong) sounds. IF -

OK

NOT OK

1. The DC MAIN BUS caption remains extinguished - *renew 'A' System Main DC Undervolt Unit (124).
2. The DC MAIN BUS caption is illuminated but the M/W ELEC caption is not illuminated and/ or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).

```
D.*******************************************
  *Reset the 'A' SYS MAIN U/V UNIT SUP      *
  *circuit breaker 1P13 on panel 15-215, map *
  *ref.A.2. Check that the DC MAIN BUS       *
  *caption is extinguished and the M/W amber *
  *caption is  extinguished. Locate the test *
  *button on each battery charge controller  *
  *'A' (1P35) and 'B' (2P35) and observe the *
  *the associated BATT - FAIL/ISOL captions. *
  *Apply the following test procedures to 'A'*
  *and 'B' battery charge controllers, in    *
  *turn:-                                    *
  *(a) Press, and hold depressed, the test   *
  *    button. Check that after a period not *
  *    exceeding 6 s, the FAIL section of the*
  *    associated BATT - FAIL/ISOLATE caption*
  *    is illuminated, the M/W amber ELEC    *
  *    caption is illuminated and the audio  *
  *    warning (single-stroke gong) sounds.  *
  *(b) Release the test button and check that*
  *    the FAIL section of the associated    *
  *    BATT - FAIL/ISOL caption is           *
  *    extinguished and the M/W amber ELEC   *
  *    caption is extinguished.  IF-        *
  ******************************************
            |    |
            |    |        ----------------------------------
            |    |       |1. The FAIL section of the associ-|
            OK   NOT OK------|   ated BATT - FAIL/ISOLATE           |
            |            |   caption remains extinguished   |
            |            |   after the test button has been |
            |            |   depressed for 6 s - check the  |
            |            |   operation of the battery charge|
            |            |   controller and associated      |
            |            |   indicators (Ref. para.10.).    |
            |            |2. After the test button has been |
            |            |   depressed for 6 s, the FAIL    |
            |            |   section of the associated      |
            |            |   BATT - FAIL/ISOL caption is    |
            |            |   illuminated but the M/W amber  |
            |            |   ELEC caption is not illuminated|
            |            |   and/or no audio warning is     |
            |            |   given - refer to Trouble       |
            |            |   Shooting of the Master Warning |
            |            |   System (Ref. 33-15-00) and/or  |
            |            |   the Audio Warning System       |
            |            |   (Ref. 31-23-00).               |
```

3. When the test button is released, the FAIL section of the associated BATT - FAIL/ISOL caption remains illuminated, (the M/W amber ELEC caption remains illuminated) - check the operation of the battery charge controller and associated indicators (Ref. para.10.)

E. *Press the RECALL button on the M/W display panel and ensure that the red ELEC and amber ELEC captions remain extinguished; some other M/W captions may be illuminated. Press the face of all other captions on the M/W panel that are illuminated and check that each is extinguished (warning cancelled).
Apply the following master warning (M/W) test procedures to each caption, No.1 AC ESS BUS, No.2 AC ESS BUS, NO.3 AC ESS BUS, No.4 AC ESS BUS, 'A' system DC ESS BUS, and 'B' system DC ESS BUS, in turn:-
(a) Press the face of the caption and check that the caption is illuminated, the red ELEC caption on the M/W display panel is illuminated and the audio warning (single-stroke gong) sounds.
(b) Release the face of the caption and check that the caption is extinguished and the red ELEC caption on the M/W display panel is extinguished. IF -

OK

NOT OK

1. When an AC ESS BUS or DC ESS BUS caption is pressed, the caption is not illuminated, the M/W red ELEC caption is not illuminated and no audio warning is given - *renew AC ESS BUS Caption Light Module (45), (46), (47) or (48) or DC ESS BUS Caption Light Module (79) or (80).

2. When an AC ESS BUS or DC ESS BUS caption is pressed, the caption is illuminated, but the M/W red ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).
3. When released after satisfactory operation, an AC ESS BUS or DC ESS BUS caption remains illuminated - renew AC ESS BUS Caption Light Module (45), (46), (47) or (48) or DC ESS BUS Caption Light Module (79) or (80).

F. Trip the 'A' ESS U/VOLT UNIT SUP circuit breaker 1P26 on panel 1-213, map ref.M8. Check that the 'A' system DC ESS BUS caption is illuminated, the M/W red ELEC caption is illuminated and the audio warning (single-stroke gong) sounds. IF -

OK

NOT OK

1. The 'A' system DC ESS BUS caption remains extinguished - *renew 'A' System Essential Undervolt Relay (81).
2. The 'A' system DC ESS BUS caption is illuminated but the M/W red ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).

```
                 |
G.*******************************************
  *Reset the 'A' ESS U/VOLT UNIT SUP circuit *
  *breaker 1P26 on panel 1-213, map ref.M8.  *
  *Check that the 'A' system DC ESS BUS      *
  *caption is extinguished and the M/W red   *
  *ELEC caption is extinguished.  Trip the   *
  *'B' ESS U/VOLT UNIT SUP circuit breaker   *
  *2P26 on panel 3-213, map ref.E12. Check   *
  *that the 'B' system DC ESS BUS caption is *
  *illuminated, the M/W red ELEC caption is  *
  *illuminated and the audio warning (single-*
  *stroke gong) sounds.  IF -                *
  *******************************************
                 |    |
                 |    |          ------------------------------------
                 |    |         |1. The 'B' system DC ESS BUS        |
                 OK   NOT OK----|   caption remains extinguished -   |
                 |              |   *renew 'B' System Essential      |
                 |              |   Undervolt Relay (83).            |
                 |              |2. The 'B' system DC ESS BUS        |
                 |              |   caption is illuminated but the   |
                 |              |   M/W red ELEC caption is not      |
                 |              |   illuminated and/or no audio      |
                 |              |   warning is given - refer to      |
                 |              |   Trouble Shooting of the Master   |
                 |              |   Warning System (Ref. 33-15-00)   |
                 |              |   and/or the Audio Warning System  |
                 |              |   (Ref. 31-23-00).                 |
                 |               ------------------------------------
                 |
H.*******************************************
  *Reset the 'B' ESS U/VOLT SUP circuit      *
  *breaker 2P26 on panel 3-213, map ref.E12. *
  *Check that the 'B' system DC ESS BUS      *
  *caption is extinguished and the M/W red   *
  *ELEC caption is extinguished.  Apply the  *
  *following master warning (M/W)test       *
  *procedure to the emergency generator      *
  *O/HEAT caption:-                          *
```

```
*(a) Press the face of the caption and      *
*    check that the caption is illuminated,*
*    the red ELEC caption on the M/W        *
*    display panel is illuminated and the   *
*    audio warning (single-stroke gong)     *
*    sounds.                                *
*(b) Release the face of the caption and    *
*    check that the caption is extinguished*
*    and the red ELEC caption on the M/W    *
*    display panel is extinguished.  IF -   *
********************************************
              |    |
              |    |         ------------------------------------
              |    |        |1. When the O/HEAT caption is       |
              OK   NOT OK---|   pressed the caption is not       |
              |             |   illuminated, the M/W red ELEC    |
              |             |   caption is not illuminated, and  |
              |             |   no audio warning is given -      |
              |             |   *renew the Emergency Generator   |
              |             |   Caption Light Module (103).      |
              |             |2. When the O/HEAT caption is       |
              |             |   pressed, the caption is illumin- |
              |             |   ated, but the M/W red ELEC       |
              |             |   caption is not illuminated and/  |
              |             |   or no audio warning is given -   |
              |             |   refer to Trouble Shooting of the |
              |             |   Master Warning System (Ref.      |
              |             |   33-15-00) and/or the Audio       |
              |             |   Warning System (Ref. 31-23-00).  |
              |             |3. When released after satisfactory|
              |             |   operation, the O/HEAT caption    |
              |             |   remains illuminated - renew the  |
              |             |   Emergency Generator  O/HEAT      |
              |             |   Caption Light Module (103).      |
              |              ------------------------------------
              |
I.********************************************
 *Apply the following master warning (M/W) *
 *test procedures to each caption CSD 1,   *
 *CSD 2, CSD 3, and CSD 4, in turn:-       *
 *(a) Press the face of the caption and    *
 *    check that the caption is illumina-  *
 *    ted, the amber ELEC caption on the   *
 *    M/W display panel is illuminated and *
 *    the audio warning (single-stroke     *
 *    gong) sounds.                        *
```

*(b) Release the face of the caption and check that the caption is extinguished and the amber ELEC caption on the M/W display panel is extinguished. IF-

OK

NOT OK

1. When a CSD caption is pressed, the caption is not illuminated, the M/W amber ELEC caption is not illuminated and no audio warning is given - check for 28 V d.c. output at the appropriate supply CB: CB(187) (CSD2); CB(188) (CSD1); CB(189) (CSD4); CB(190) (CSD3). If absent, renew Circuit Breaker (187), (188), (189) or (190). If present, *renew CSD Caption Light Module (195), (196), (197) or (198).
2. When a CSD caption is pressed, the caption is illuminated, but the M/W amber ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).
3. When released after satisfactory operation, a CSD caption remains illuminated - renew CSD Caption Light Module (195), (196), (197) or (198).

J. *Set both battery control switches to "OFF". Remove the safety clips and reset CBs (181) and (182), then ensure that the generator (GEN) failure captions GEN 1, GEN 2, GEN 3 and GEN 4 are illuminated. IF -

```
         |     |
         |     |
         |     |        |1. A GEN failure caption remains
        OK   NOT OK-----|   extinguished - Chart 122.
         |              |2. GEN failure captions GEN 1 and
         |              |   GEN 2 or GEN 3 and GEN 4 remain
         |              |   extinguished - check for 28 V
         |              |   d.c. output at CB (181) or
         |              |   (182); renew CB or rectify O/C
         |              |   as necessary.
         |
K.********************************************
  *Set the ground power control switch on the*
  *electrical generating control panel to    *
  *"TRIP" and release it.  Reconnect the IDG *
  *oil low pressure switch connectors        *
  *disconnected in Preparation paragraph 2.L.*
  *i.e., 1X1-C, 2X1-C, 3X1-C abd 4X1-C.      *
  *Tighten and wire-lock each connector (Ref.*
  *Wiring Diagram Manual, 20-42-48). Set     *
  *the ground power control switch to "CLOSE"*
  *and release it and check that the CSD     *
  *failure captions CSD 1, CSD 2, CSD 3, and *
  *CSD 4 are illuminated.  IF -              *
  ********************************************
         |     |
         |     |        |A CSD failure caption remains
        OK   NOT OK-----|extinguished - Chart 123.
         |
L.*********************************************
  *Close the engine bay doors (Ref. 71-00-00).*
  *********************************************
```

14. Trouble Shooting - AC Generation - Using Main Engines

```
A.********************************************
  *Prepare to trouble shoot (Ref. para.2.M.).*
  *Check that the generator (GEN) failure    *
  *captions GEN 1, GEN 2, GEN 3 and GEN 4 are*
  *illuminated and that Nos.1, 2, 3 and 4    *
  *generator circuit breaker (GCB) position  *
  *magnetic indicators display cross-line.   *
  *IF -                                      *
  ********************************************
         |     |
```

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
                |     |
                |     |                -----------------------------------
                |     |               |1. A GEN failure caption remains   |
                OK    NOT OK------|      extinguished - Chart 122.        |
                |                     |2. GEN failure captions GEN 1 and  |
                |                     |   GEN 2 or GEN 3 and GEN 4 remain |
                |                     |   extinguished - check for 28 V   |
                |                     |   d.c. output at CB (181) or      |
                |                     |   (182);  renew CB or rectify O/C |
                |                     |   as necessary.                   |
                |                     |3. A GCB position magnetic         |
                |                     |   indicator displays in-line -    |
                |                     |   renew GCB magnetic indicator    |
                |                     |   (169), (170), (171) or (172).   |
                |                      -----------------------------------
                |
B.*******************************************
  *Check that the constant speed drive (CSD) *
  *failure captions CSD 1, CSD 2, CSD 3 and  *
  *CSD 4 are illuminated.  IF -              *
  *******************************************
                |     |
                |     |                -----------------------------------
                |     |               |A CSD failure caption remains      |
                OK    NOT OK------|extinguished - Chart 123.          |
                |                      -----------------------------------
                |
C.*******************************************
  *Start and run No.1 engine at a speed above*
  *62 per cent N2, noting the procedures to  *
  *be carried out if excessive CSD OIL INLET *
  *temperature is indicated during the       *
  *engine run (Ref. 71-00-00). Check that    *
  *the associated CSD failure caption is     *
  *extinguished, the associated GEN failure  *
  *caption is extinguished, and the associ-  *
  *ated GCB position magnetic indicator      *
  *displays in-line.  IF -                   *
  *******************************************
                |     |
                |     |                -----------------------------------
                |     |               |1. The associated CSD failure      |
                OK    NOT OK------|      caption remains illuminated with|
                |                     |   the associated GEN failure      |
                |                     |   caption extinguished -          |
                |                     |   Chart 124.                      |
                |                     |2. The associated CSD failure and  |
                |                     |   GEN failure captions both remain|
                |                     |   illuminated - renew IDG (199).  |
```

3. The associated GEN failure caption remains illuminated with the associated GCB position magnetic indicator displaying cross-line - Chart 125.
4. The associated GEN failure caption remains illuminated with the associated GCB position magnetic indicator displaying in line - disconnect terminal 2 of GEN Caption Light Module (173). If fault is cleared, renew GCB (177). If fault remains, renew GEN Caption Light Module (173).
5. The associated GEN failure caption is extinguished with the associated GCB position magnetic indicator displaying cross-line - check for 28 V d.c. at terminal A of GCB position magnetic indicator. If present, *renew GCB position magnetic indicator (169); if absent, *renew GCB (177).

D. With No.1 engine running at a speed above 62 per cent N2, check that the auto shed breaker (ASB) position magnetic indicator displays in-line. IF -

- OK
- NOT OK ------ ASB position magnetic indicator displays cross-line - Chart 126.

E.***
*Start and run Nos.2, 3 and 4 engines, in *
*turn, at a speed above 62 per cent N2, *
noting the procedures to be carried out if
*excessive CSD OIL INLET temperature is *
*indicated during the engine run *
(Ref. 71-00-00). Check that as each engine
*runs up to speed, the associated CSD *
*failure caption is extinguished, *
*the associated GEN failure caption is *
*extinguished, and the associated GCB *
*position magnetic indicator displays in- *
*line. If paralleling of a generator *
*(closure of the associated GCB) does not *
*accur automatically, use the parallel *
*assist (P/ASSIST) switch facility as *
*described in the Adjustment/Test *
*procedure. IF- *
****

OK

NOT OK:

1. A CSD failure caption remains illuminated with the associated GEN failure caption extinguished - Chart 124.
2. A CSD failure caption and the associated GEN failure caption both remain illuminated - renew IDG (200), (201) or (202).
3. A GEN failure caption remains illuminated with the associated GCB position magnetic indicator displaying cross-line - Chart 127.
4. A GEN failure caption remains illuminated with the associated GCB position magnetic indicator displaying in-line - disconnect terminal 2 of GEN Caption Light Module (174), (175) or (176). If fault is cleared, renew GCB (178), (179) or (180). If fault remains, renew GEN Caption Light Module (174), (175) or (176).

```
                   |              |5. A GEN failure caption is           |
                   |              |   extinguished with the associated   |
                   |              |   GCB position magnetic indicator    |
                   |              |   displaying cross-line.  Check      |
                   |              |   for 28 V d.c. at terminal A of     |
                   |              |   GCB position magnetic indicator.   |
                   |              |   If present, *renew GCB position    |
                   |              |   magnetic indicator (170), (171)    |
                   |              |   or (172);  if absent, *renew GCB   |
                   |              |   (178), (179) or (180).             |
                   |               -----------------------------------
                   |
F.*********************************************
  *Set the AC FREQ/VOLTS selector switch to  *
  *"GEN 1", "GEN 2", "GEN 3" and "GEN 4", in *
  *turn, and check that the nominal voltage  *
  *and frequency (approx. 115 V 400 Hz) are  *
  *displayed on the voltmeter and frequency  *
  *meter at each switch position.  IF -      *
  *********************************************
                   |    |
                   |    |          -----------------------------------
                   |    |         |Voltage and frequency are not      |
                  OK   NOT OK------|displayed when the associated      |
                   |              |generator is selected at the AC    |
                   |              |FREQ/VOLTS selector switch -       |
                   |              |Chart 128.                         |
                   |               -----------------------------------
                   |
G.*********************************************
  *Check that the paralleling of Nos.1, 2, 3 *
  *and 4 main generation channels is         *
  *established, by observing that Nos.1, 2, 3*
  *and 4 bus-tie breaker (BTB) position      *
  *magnetic indicators display in-line with  *
  *Nos.1, 2, 3 and 4 AC MAIN BUS captions and*
  *Nos.1, 2, 3 and 4 AC ESS BUS captions     *
  *extinguished.   IF -                      *
   ------------------------------------------
                   |    |
                   |    |          -----------------------------------
                   |    |         |A BTB position magnetic indicator  |
                  OK   NOT OK------|displays cross-line - Chart 129.   |
                   |               -----------------------------------
                   |
```

```
H.******************************************
  *Note the reading in kilowatts indicated on*
  *Nos.1, 2, 3 and 4 KW/KVAR meters.  Check  *
  *that any difference in load sharing, so   *
  *indicated, does not exceed 6 kW.  Press   *
  *the PUSH FOR KVAR push-switch and note the*
  *reading on Nos.1, 2 3 and 4 KW/KVAR       *
  *meters.  Check that any difference in load*
  *sharing, so indicated, does not exceed    *
  *4 kVAR.  IF -                             *
  ******************************************
           |    |
           |    |
           OK   NOT OK------|
```

1. A KW/KVAR meter gives zero KW indication (PUSH FOR KVAR switch released) - Chart 130.
2. Nos.1 and 2 or 3 and 4 KW/KVAR meters give zero KVAR indication, i.e., when PUSH FOR KVAR switch is operated - *renew associated KW/KVAR C/O Relay (224)or (225).
3. A KW/KVAR meter gives zero KVAR indication, i.e., when PUSH FOR KVAR switch is operated - Chart 131.
4. All KW/KVAR meters continue to give KW indication when PUSH FOR KVAR switch is operated - *renew PUSH FOR KVAR switch (226).
5. A KW/KVAR meter continues to give KW indication when PUSH FOR KVAR switch is operated - renew the associated C/O relay, i.e., *renew Nos.1 & 2 Meters KW/KVAR C/O Relay (224) or *renew Nos.3 & 4 Meters KW/KVAR C/O Relay (225).
6. A KW/KVAR meter indicates a load sharing difference exceeding 6 kW - Chart 132.
7. A KW/KVAR meter indicates a load sharing difference exceeding 4 kVAR - Chart 133.

```
                 |
I.**********************************************
  *Check that the oil temperature of each IDG*
  *is indicated on the INLET and DIFF scales *
  *of the correspondingly-numbered CSD oil   *
  *temperature indicator and that the over-  *
  *heat warning lamp on the front of each    *
  *indicator is not lit.  IF -               *
  *                                          *
  *NOTE:  Under ground running conditions,   *
  *       the oil inlet temperature and      *
  *       differential temperature will be   *
  *       approximately 80 deg C and 15 deg C*
  *       respectively.  These values will   *
  *       vary according to the generator    *
  *       load and ambient temperature.      *
  ********************************************
             |    |
             |    |         ----------------------------------
             |    |        |The temperature indicated on the  |
             OK   NOT OK---|INLET or DIFF scale of a CSD oil  |
             |             |temperature indicator is          |
             |             |abnormally high or abnormally low |
             |             |or the overheat warning lamp on   |
             |             |the front of the indicator is lit |
             |             |- record the fault indication,    |
             |             |then check the oil temperature    |
             |             |indication circuits (Ref. 24-11-00|
             |             |Adjustment/Test) and trouble      |
             |             |shoot accordingly.  If no faults  |
             |             |found, retain the record of the   |
             |             |fault indication and refer to     |
             |             |Chart 134.                        |
             |              ----------------------------------
             |
```

```
J.*****************************************
  *Apply the following master warning (M/W)  *
  *test procedures to each failure caption,  *
  *GEN 1, GEN 2, GEN 3 and GEN 4, in turn:-  *
  *(a) Press the face of the caption and     *
  *    check that the caption is illuminated,*
  *    the amber ELEC caption on the M/W     *
  *    display panel is illuminated and the  *
  *    audio warning (single-stroke gong)    *
  *    sounds.                               *
  *(b) Release the face of the caption and   *
  *    check that the caption is extinguished*
  *    and the amber ELEC caption on the M/W *
  *    display panel is extinguished.  IF -  *
  *******************************************
            |         |
            |         |          -----------------------------------
            |         |         |1. When a GEN failure caption is    |
           OK    NOT OK------|   pressed, the caption is not        |
            |                   |   illuminated, the M/W amber ELEC |
            |                   |   caption is not illuminated and  |
            |                   |   no audio warning is given -     |
            |                   |   *renew GEN Caption Light Module |
            |                   |   (173), (174), (175) or (176).   |
            |                   |2. When a GEN failure caption is    |
            |                   |   pressed, the caption is illumi- |
            |                   |   nated, but the M/W amber ELEC   |
            |                   |   caption is not illuminated and/ |
            |                   |   or no audio warning is given -  |
            |                   |   refer to Trouble Shooting of the|
            |                   |   Master Warning System (Ref.     |
            |                   |   33-15-00) and/or the Audio      |
            |                   |   Warning System (Ref. 31-23-00). |
            |                   |3. When released after satisfactory|
            |                   |   operation, a GEN failure        |
            |                   |   caption remains illuminated -   |
            |                   |   renew the appropriate (GEN)     |
            |                   |   Caption Light Module (173),     |
            |                   |   (174), (175) or (176).          |
            |                    -----------------------------------
            |
```

R **ON A/C 007-007,

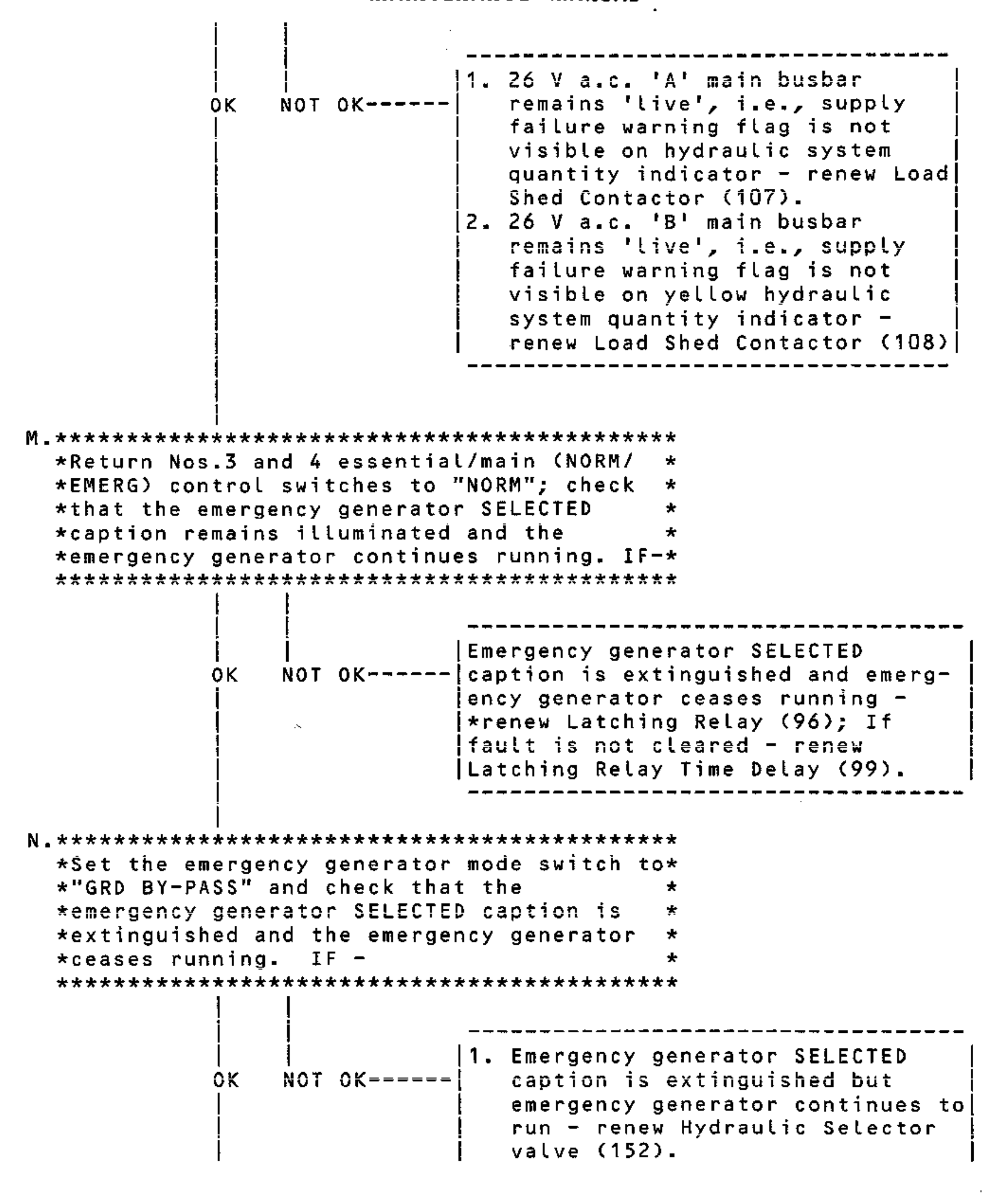
```
K.******************************************
  *Check that the emergency generator mode   *
  *switch is at AUTO. Set Nos.2 and 3        *
  *essential/main (NORM/EMERG)control        *
  *switches to "EMERG".  Check that the      *
  *emergency generator starts running, i.e., *
  *the SELECTED caption is illuminated and   *
  *the FAIL caption is not illuminated. Check*
  *also that Nos.2 and 3 AC ESS BUS captions *
  *are extinguished, indicating that the     *
  *emergency generator output is connected to*
  *the associated busbars via the 'A' and 'B'*
  *system emergency busbars, and that the    *
  *emergency generator voltage and frequency *
  *are correct (approx. 115 V 400 Hz) and not*
  *fluctuating.  IF -                        *
  ********************************************
             |    |
             |    |          -----------------------------------
             |    |         |1. SELECTED caption not illuminated|
             OK   NOT OK------|   i.e., emergency generator is not|
             |              |   started - * renew Override Relay|
             |              |   (237); if fault is not cleared, |
             |              |   *renew Emergency Generator Mode |
             |              |   Switch (92).                    |
             |              |2 With the emergency generator     |
             |              |   SELECTED caption illuminated,   |
             |              |   the FAIL caption is also        |
             |              |   illuminated - press-to-test the |
             |              |   emergency generator FAIL caption|
             |              |   and check that fault is cleared.|
             |              |   If YES, check the fault indica- |
             |              |   tion on the emergency Generator |
             |              |   Control and Protection Unit     |
             |              |   (CPU) (88).                     |
             |              |NOTE:  With the emergency generator|
```

running on test after clearance of an overvoltage (O/V) or differential protection (DP) fault, the FAIL caption must be pressed -to-test (CPU reset) to reinstate the generator output, and the fault indicator on the CPU (88) must be reset by insertion of a suitable probe through the CPU front panel to activate the appropriate reset micro-switch, SW1 (O/V) or SW5 (DP).

If fault is not cleared, i.e., FAIL caption remains illuminated, apply an Emergency Generation Functional Test Using Hydraulic Ground Power and trouble shoot accordingly (Ref. para.12.).

3. No.2 or No.3 AC ESS BUS is illuminated with all other indications correct - *renew Essential/Main Change-over Contactor (55) or (56).
4. No.3 AC ESS BUS caption illuminated with emergency generator SELECTED caption illuminated and FAIL caption extinguished - *renew ASB (100).
5. Emergency generator voltage and/or frequency indications are fluctuating - renew Emergency Generator and Drive Unit (162).

L. With Nos.2 and 3 essential/main (NORM/EMERG) control switches set to "EMERG", check that the 'A' and 'B' system 26 V a.c. main busbars are shed, by observing that the power supply failure warning flag is visible on the blue system quantity indicator and the yellow system quantity indicator on the hydraulic management panel. IF -


OK
NOT OK
1. 26 V a.c. 'A' main busbar remains 'live', i.e., supply failure warning flag is not visible on hydraulic system quantity indicator - renew Load Shed Contactor (107).
2. 26 V a.c. 'B' main busbar remains 'live', i.e., supply failure warning flag is not visible on yellow hydraulic system quantity indicator - renew Load Shed Contactor (108)
M. Return Nos.3 and 4 essential/main (NORM/EMERG) control switches to "NORM"; check that the emergency generator SELECTED caption remains illuminated and the emergency generator continues running. IF-
OK
NOT OK
Emergency generator SELECTED caption is extinguished and emergency generator ceases running - *renew Latching Relay (96); If fault is not cleared - renew Latching Relay Time Delay (99).
N. Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator SELECTED caption is extinguished and the emergency generator ceases running. IF -
OK
NOT OK
1. Emergency generator SELECTED caption is extinguished but emergency generator continues to run - renew Hydraulic Selector valve (152).

```
          |                 |2. Emergency generatpr. SELECTED   |
          |                 |   caption remains illuminated and |
          |                 |   emergency generator continues to|
          |                 |   run - renew Emergency Generator |
          |                 |   Mode Switch (92).               |
          |                  -----------------------------------
          |
O.**********************************************
  *Shut down No.1 engine (Ref. 71-00-00) and *
  *check that when the engine speed falls    *
  *below 58 per cent N2, the emergency       *
  *generator does not commence running, i.e.,*
  *the SELECTED caption is not illuminated.  *
  *IF -                                      *
  ********************************************
          |    |
          |    |             -----------------------------------
          |    |            |The emergency generator SELECTED   |
         OK   NOT OK--------|caption is illuminated - Chart 135.|
          |                  -----------------------------------
          |
P.**********************************************
  *Shut down No.2 engine (Ref. 71-00-00) and *
  *check that when the engine speed falls    *
  *below 58 per cent N2, the ASB position    *
  *magnetic indicator changes from in-line to*
  *cross-line and the emergency generator    *
  *SELECTED caption is illuminated (the      *
  *generator starts running), followed by    *
  *illumination of the FAIL caption after a  *
  *short period. (The starting and subsequent*
  *run-down of the emergency generator, as   *
  *indicated, is explained in the Adjustment/*
  *Test).  IF -                              *
  ********************************************
          |    |
          |    |
          |    |             -----------------------------------
          |    |            |1. The ASB position magnetic       |
         OK   NOT OK--------|   indicator remains in-line and   |
          |                 |   the emergency generator SELECTED|
          |                 |   caption is not illuminated -    |
          |                 |   renew Engine Speed Unit (95).   |
```

2. The ASB position magnetic indicator changes from in-line to cross-line but the emergency generator SELECTED caption is not illuminated - *renew Engine Speed Unit (95).
3. The emergency generator SELECTED caption is illuminated, but the ASB position magnetic indicator remains in-line - renew Engine Speed Unit (95).

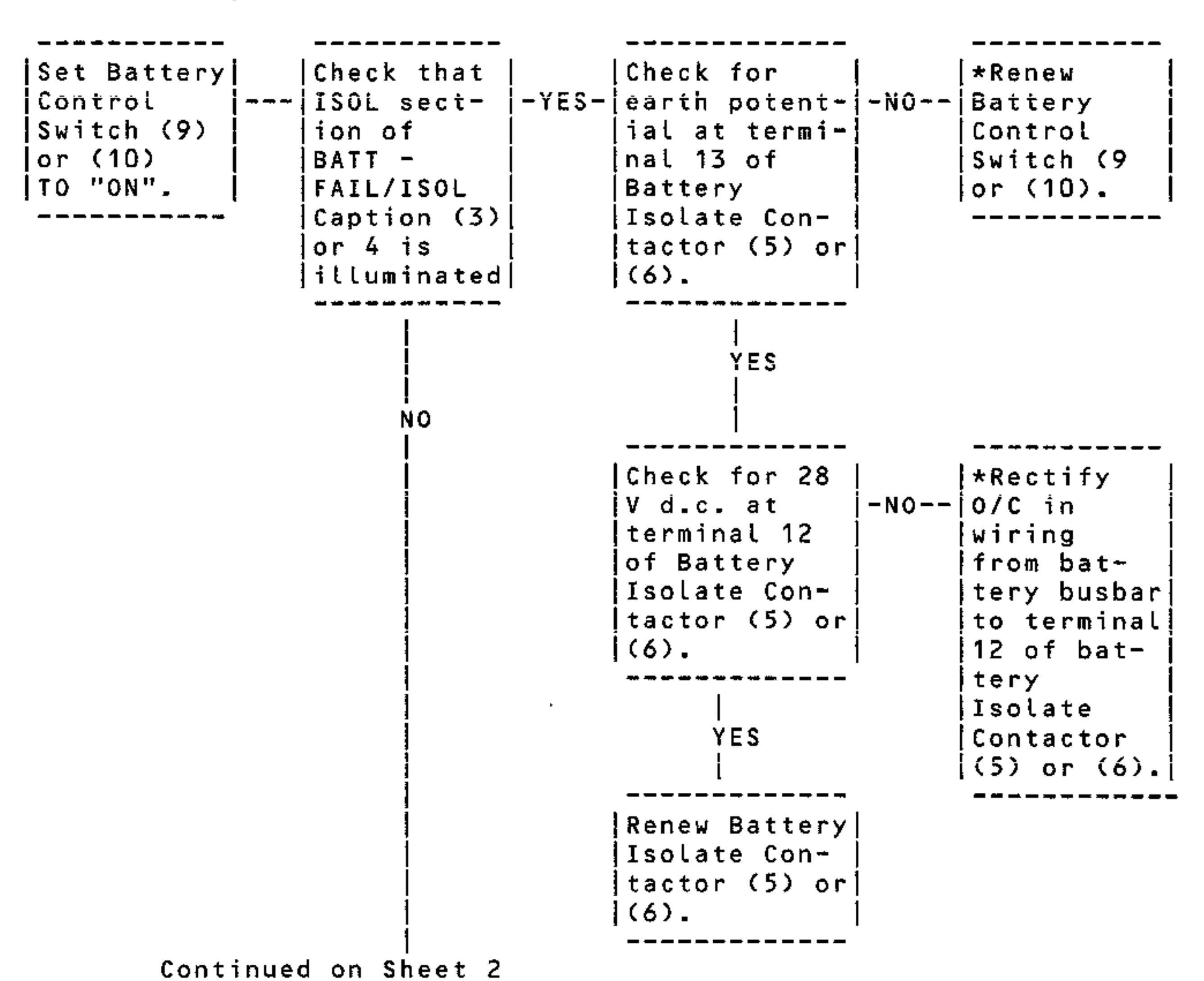
Q. *Set the emergency generator mode switch to "AUTO". Set the emergency generator isolate switch to "ISOL" and then back to "NORM" to extinguish the emergency generator SELECTED and FAIL captions. Shut down Nos.3 and 4 engines (Ref. 71-00-00). Set BATT A and BATT B control switches to "OFF".*

R **ON A/C 007-007,

```
********************************
*BATTERY ISOLATE MAGNETIC      *
*INDICATOR REMAINS CROSS-LINE  *
*WHEN BATTERY IS SWITCHED ON.  *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.



Continued on Sheet 2

Chart 101 (Sheet 1 of 2)

Continued from Sheet 1

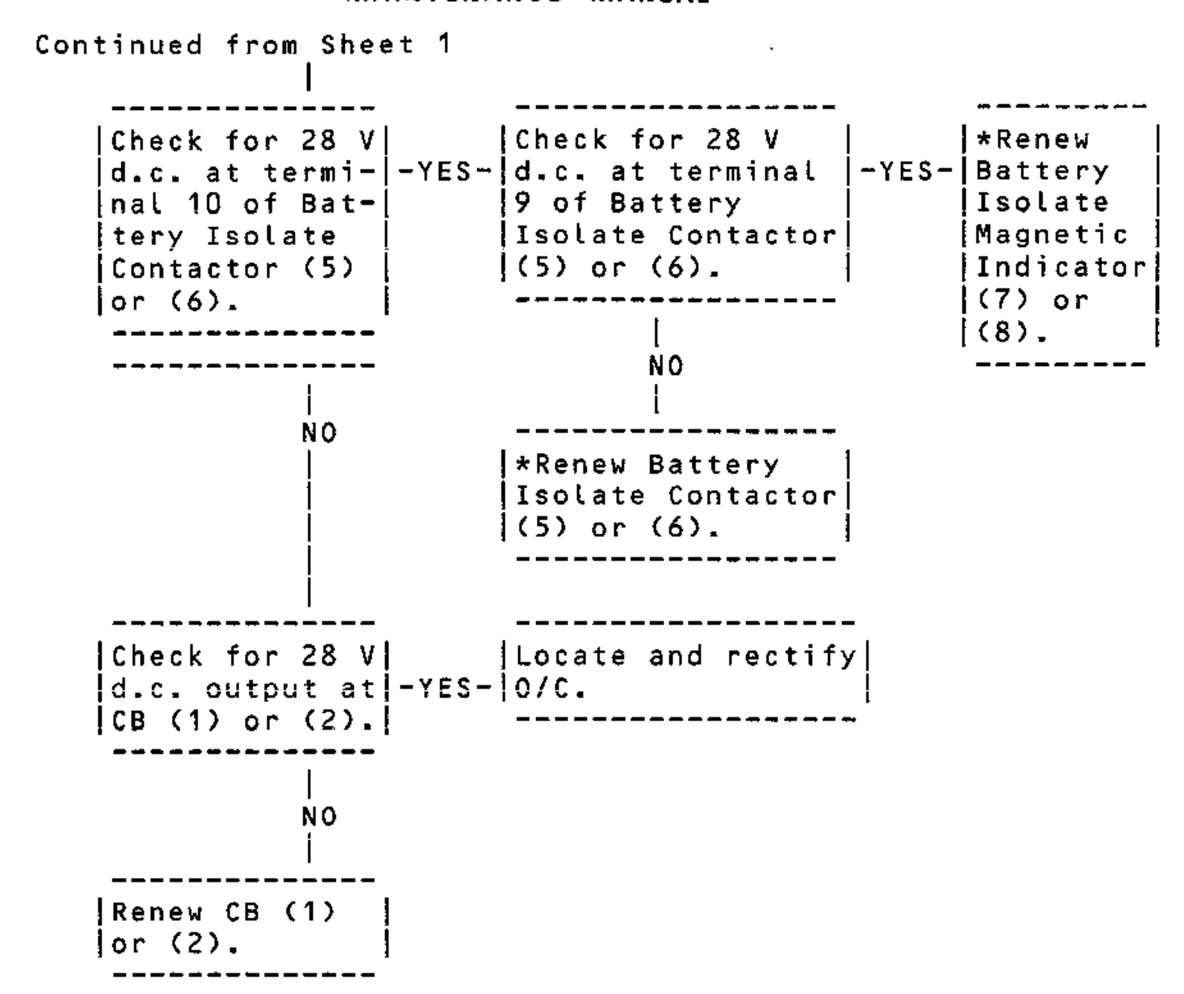


Chart 101 (Sheet 2 of 2)

```
*******************************
*EITHER (A OR B) ESSENTIAL/   *
*MAIN SPLIT MAGNETIC INDICATOR*
*REMAINS IN-LINE WITH         *
*DC NORM/SPLIT CONTROL SWITCH *
*SET TO 'SPLIT'.              *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-

```
 -----------     ------------      ------------       -----------
|Set DC     |   |Trip indi-  |    |Reset CB    |     |Renew      |
|NORM/SPLIT |---|cator supply|-YES-|(228). Trip |-YES-|DC NORM/   |
|Control    |   |CB (228).   |    |CB (229)    |     |SPLIT Con- |
|Switch     |   |Does        |    |'A' system  |     |trol Switch|
|(232) to   |   |magnetic    |    |or (230)    |     |(232). Is  |
|"SPLIT".   |   |indicator   |    |('B'        |     |fault      |
 -----------    |change to   |    |system).Does|     |cleared?   |
                |cross-line? |    |magnetic    |      -----------
                 ------------     |indicator   |           |
                       |          |change to   |           NO
                       NO         |cross-line? |           |
                       |           ------------       -----------
                 --------------         |            |Renew Bat- |
                |Renew Magnetic|        NO           |tery       |
                |Indicator (78)|        |            |Charge Con-|
                |or (79). Reset|   ----------------  |troller    |
                |CB (228).     |  |Renew associated| |(235) or   |
                 --------------   |A or B system   | |(236).     |
                                  |Essential/Main  |  -----------
                                  |Split Contactor |
                                  |(122) or (123). |
                                   ----------------
```

Chart 102

```
*******************************
*ONE 'AC MAIN BUS' CAPTION    *
*REMAINS EXTINGUISHED WHEN SSB*
*CONTROL SWITCH IS SET TO     *
*'OPEN'.                      *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

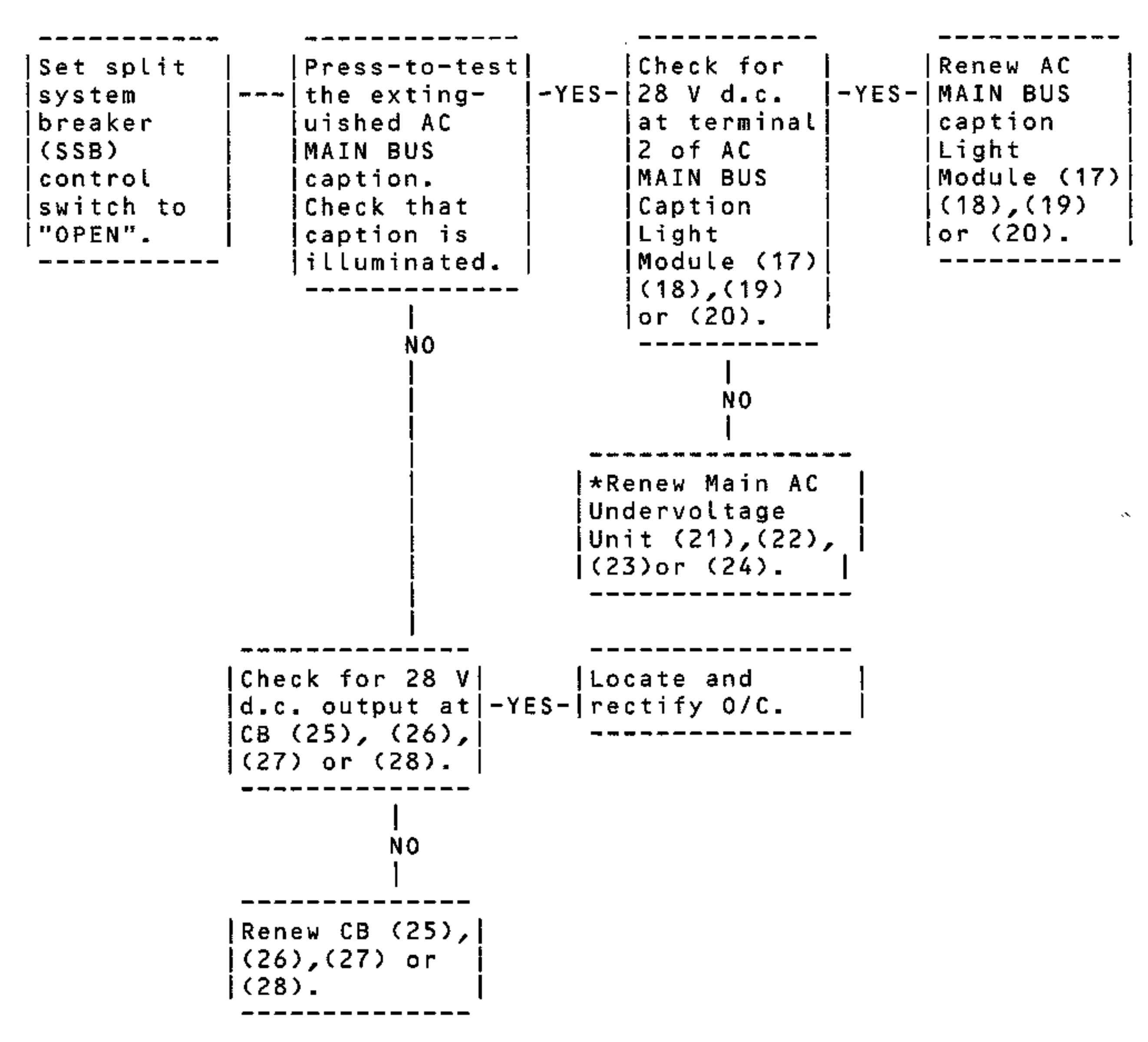


Chart 103

```
********************************
*ESSENTIAL/MAIN ISOLATE        *
*MAGNETIC INDICATOR REMAINS    *
*IN-LINE WITH ASSOCIATED BTB   *
*CONTROL SWITCH SET TO 'TRIP'.*
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 ----------      -------------       -------------       ----------
|Set BTB   |    |Check for 28 |     |Check for 28 |     |Locate and|
|control   |---|V d.c. at    |-YES-|V d.c. at    |-YES-|rectify   |
|switch to |    |terminal 11  |     |terminal X1  |     |stray     |
|"TRIP".   |    |of Essential/|     |of Essential/|     |positive  |
 ----------     |Main Change- |     |Main Change- |     |supply at |
                |over         |     |over         |     |terminal  |
                |Contactor    |     |Contactor    |     |X1.       |
                |(54),(55),   |     |(54),(55),   |      ----------
                |(56) or (57).|     |(56) or (57).|
                 -------------       -------------
                      |                   |
                      NO                  NO
                      |                   |
                 -------------       -------------
                |Renew        |     |Renew        |
                |Essential/   |     |Essential/   |
                |Main Isolate |     |Main Isolate |
                |Magnetic     |     |Change-over  |
                |Indicator    |     |Contactor    |
                |(58),(59),   |     |(54),(55),   |
                |(60) or (61).|     |(56) or (57).|
                 -------------       -------------
```

Chart 104

*ONE 'AC ESS BUS' CAPTION *
*REMAINS EXTINGUISHED WITH *
*ASSOCIATED BTB CONTROL *
*SWITCH SET TO 'TRIP'. *

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Set associated BTB control switch to "TRIP".
→ Check that the AC ESS BUS Caption Light Module (45),(46),(47) or (48) is illuminated when pressed.
- NO → *Renew Caption Light Module (45),(46),(47) or (48).
- YES → *Renew AC Essential Undervoltage Unit (41),(42), (43) or (44).

Chart 105

```
*******************************
*TRU AMMETER INDICATES LOAD   *
*WITH 'DC MAIN BUS' CAPTION   *
*EXTINGUISHED AND 'A' AND 'B' *
*ESSENTIAL/MAIN SPLIT MAGNETIC*
*INDICATORS IN-LINE AND ALL   *
*TRU CONTROL SWITCHES AT      *
*'ISOL'.                      *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------------          -----------------         -----------------
|Set all TRU      |        |Check that the   |       |Renew TRU Control|
|control switches |--------|potential at     |--NO-- |Switch (68),(69),|
|to "ISOL".       |        |terminal 2 of TRU|       |(70) or (71).    |
 -----------------         |Control Switch   |        -----------------
                           |(68),(69),(70) or|
                           |(71) is at 115 V |
                           |approx.          |
                            -----------------
                                    |
                                   YES
                                    |
                            -----------------
                           |Renew TRU Isolate|
                           |Contactor (72),  |
                           |(73),(74) or     |
                           |(75).            |
                            -----------------
```

Chart 106

```
********************************
*'DC MAIN BUS' CAPTION REMAINS*
*EXTINGUISHED WITH ALL TRUs   *
*ISOLATED.                    *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------------      -----------------       -----------------
|Set all TRU      |    |Check for 28 V   |     |Renew DC MAIN BUS|
|control switches |----|d.c. at terminal |=YES=|Caption Light    |
|to "ISOL".       |    |2 of DC MAIN BUS |     |Module (76).     |
 -----------------     |Caption Light    |      -----------------
                       |Module (76).     |
                        -----------------
                               |
                               NO
                               |
                        -----------------       -----------------
                       |Check for 28 V   |     |Locate and       |
                       |d.c. output at CB|-YES-|rectify O/C.     |
                       |(77).            |      -----------------
                        -----------------
                               |
                               NO
                               |
                        -----------------
                       |Renew CB (77).   |
                        -----------------
```

Chart 107

```
*******************************
*ESSENTIAL/MAIN SPLIT MAGNETIC*
*INDICATOR REMAINS IN-LINE    *
*WITH ALL TRUs ISOLATED.      *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------------      -----------------       -----------------
|Set all TRU      |    |Check for d.c.   |     |Renew Essential/ |
|control switches |----|supply (battery  |--NO-|Main Split       |
|to "ISOL".       |    |voltage) at      |     |Magnetic         |
 -----------------     |terminal 3 of the|     |Indicator (78)   |
                       |associated (A or |     |or (79).         |
                       |B system)        |      -----------------
                       |Essential/Main   |
                       |Split Contactor  |
                       |(122) or (123).  |
                        -----------------
                               |
                              YES
                               |
                        -----------------
                       |Renew associated |
                       |(A or B system)  |
                       |Main DC Undervolt|
                       |Unit (124) or    |
                       |(125).           |
                        -----------------
```

Chart 108

'A' or 'B' SYSTEM 'DC ESS BUS' CAPTION REMAINS EXTINGUISHED WITH ASSOCIATED BATTERY CONTROL SWITCH SET TO 'OFF'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

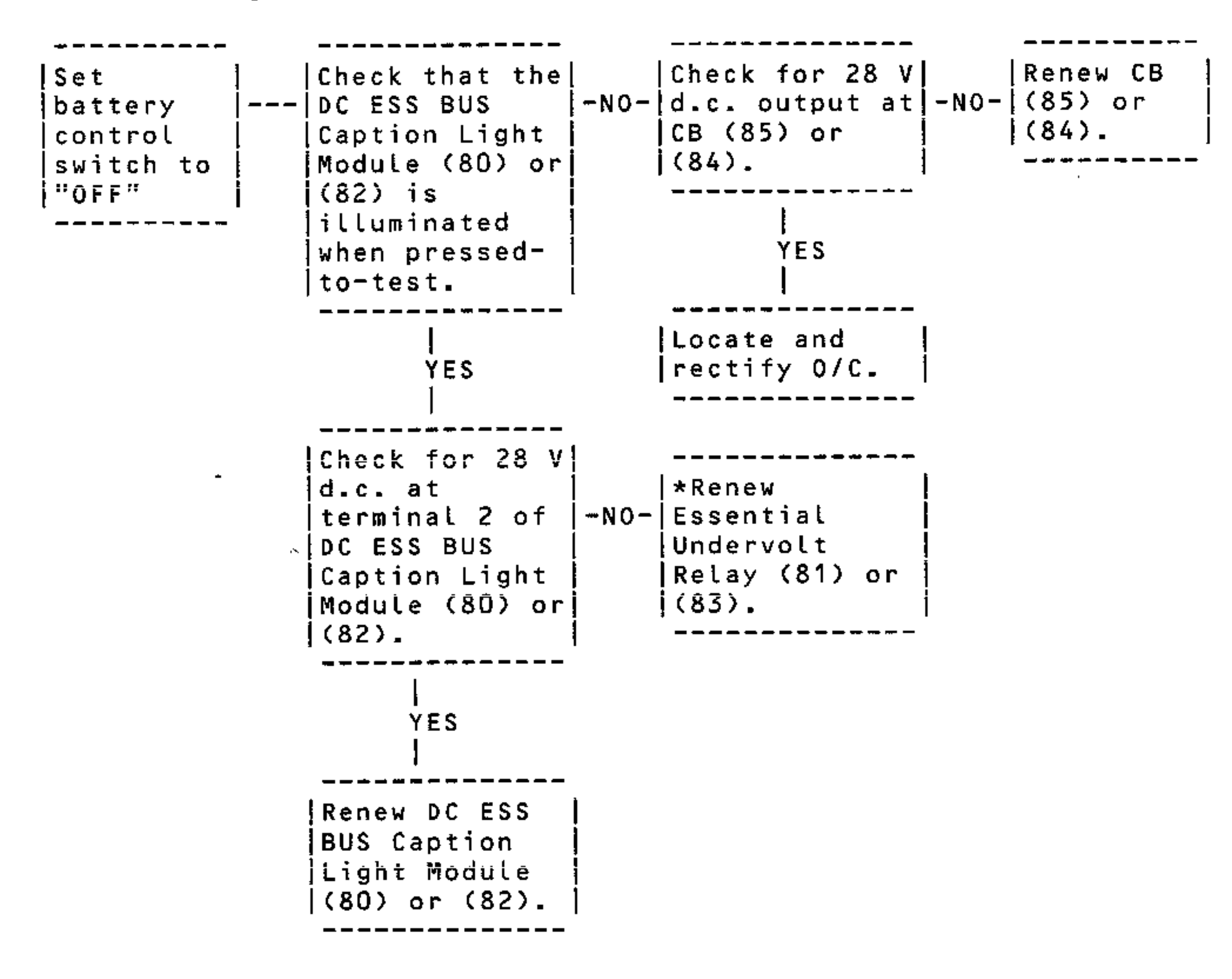


Chart 109

```
*******************************
*'FAIL' CAPTION REMAINS       *
*EXTINGUISHED WITH EMERGENCY  *
*GENERATOR MODE SWITCH SET    *
*TO 'MANUAL'.                 *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------     -------------------------          -----------------
|Set emerg- |   |Check that the FAIL      |        |Renew the FAIL   |
|ency gener-|---|Caption Light Module (87) |-NO-|Caption Light    |
|ator mode  |   |is illuminated when      |        |Module (87).     |
|switch to  |   |pressed-to-test.         |         -----------------
|"MANUAL".  |    -------------------------
 -----------                |
                           YES
                            |
                 --------------------------          -----------------
                |Remove the Emergency      |        |Locate and       |
                |Generator Control and     |-NO-|rectify O/C.     |
                |Protection Unit (88). Link|        |Remove link and  |
                |pins 16 and 10 together at|        |refit Emergency  |
                |backplate connector       |        |Generator Control|
                |X201-AA.  Check that the  |        |and Protection   |
                |FAIL caption is           |        |Unit (88).       |
                |illuminated.              |         -----------------
                 --------------------------
                            |
                           YES
                            |
                 --------------------------
                |Remove link and renew     |
                |Emergency Generator       |
                |Control and Protection    |
                |Unit (88).                |
                 --------------------------
```

Chart 110

R **ON A/C 007-007,

```
********************************
*'SELECTED' AND 'FAIL' CAPTIONS*
*REMAIN EXTINGUISHED WITH      *
*EMERGENCY GENERATOR MODE      *
*SWITCH SET TO 'MANUAL'.       *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 -----------     ----------------------       ---------------------
|Set emerg- |   |Check for 28 V d.c.   |     |Locate and rectify   |
|ency gener-| --|output at CB (89).    |-YES-|O/C.                 |
|ator mode  |    ----------------------       ---------------------
|switch to  |              |
|"MANUAL".  |              NO
 -----------               |
                 ----------------------       ---------------------
                |Check for 28 V d.c.   |-YES-|*Renew CB (89).      |
                |at terminal 4 of      |      ---------------------
                |Emergency Generator   |
                |Isolate Switch (91).  |
                 ----------------------
                           |
                           NO
                           |
                 ----------------------       ---------------------
                |Check for 28 V d.c. at|     |*Renew Emergency     |
                |terminal 11 of Emerg= |=YES-|Generator Isolate    |
                |ency Generator Mode   |     |Switch (91).         |
                |Switch (92).          |      ---------------------
                 ----------------------
                           |
                           NO
                           |
                 ----------------------       ---------------------
                |Check for 28 V d.c.   |     |*Renew Emergency     |
                |output at CB (90).    |-YES-|Generator Mode       |
                 ----------------------      |Switch (92).         |
                           |                  ---------------------
                           NO
                           |
                 ----------------------
                |Renew CB (90).        |
                 ----------------------
```

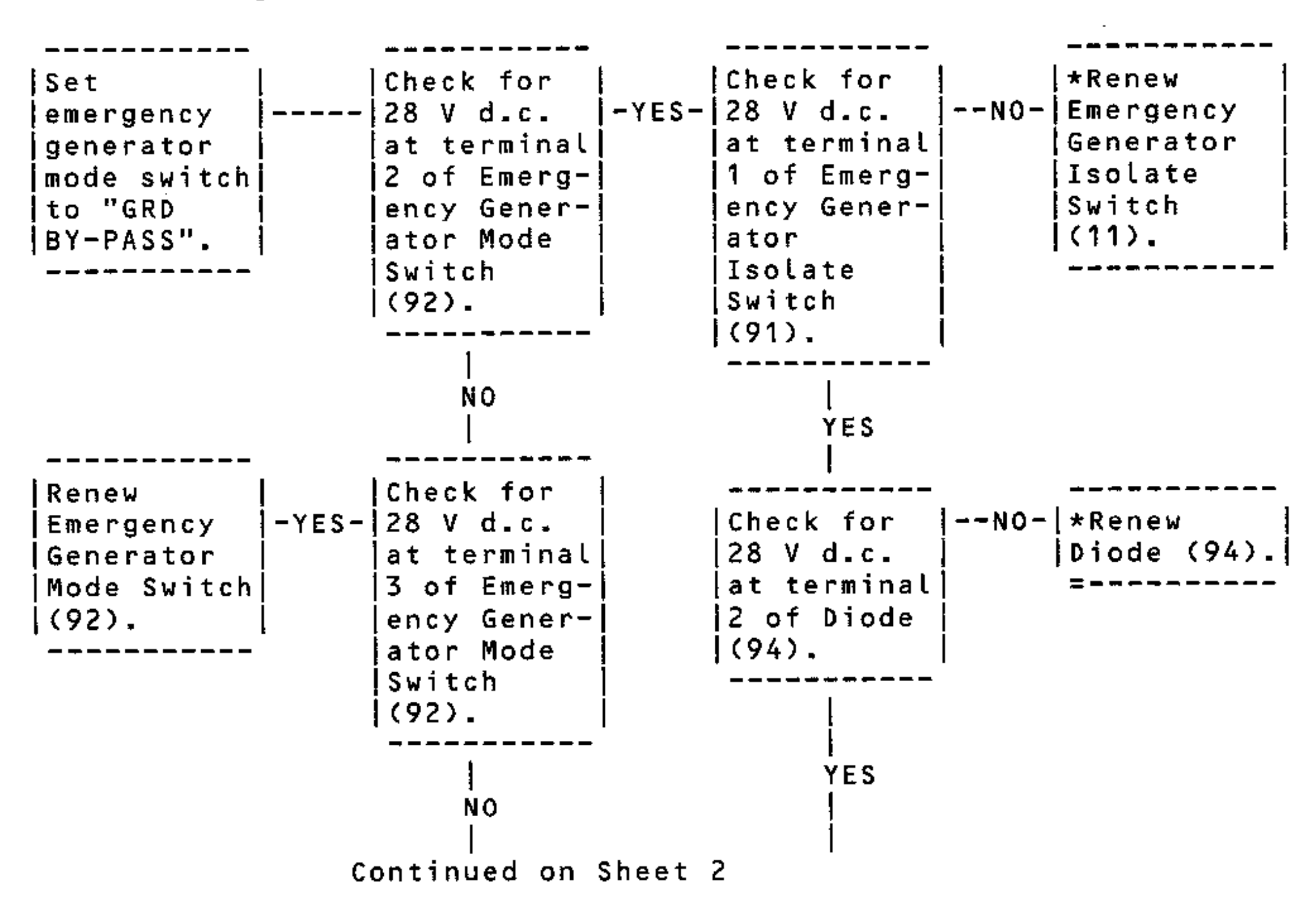
Chart 111

Printed in England

```
*******************************
*'SELECTED' AND 'FAIL'        *
*CAPTIONS ARE EXTINGUISHED    *
*WHEN EMERGENCY GENERATOR MODE*
*SWITCH IS SET TO 'GRD        *
*BY-PASS'.                    *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.



Continued on Sheet 2

Chart 112 (Sheet 1 of 2)

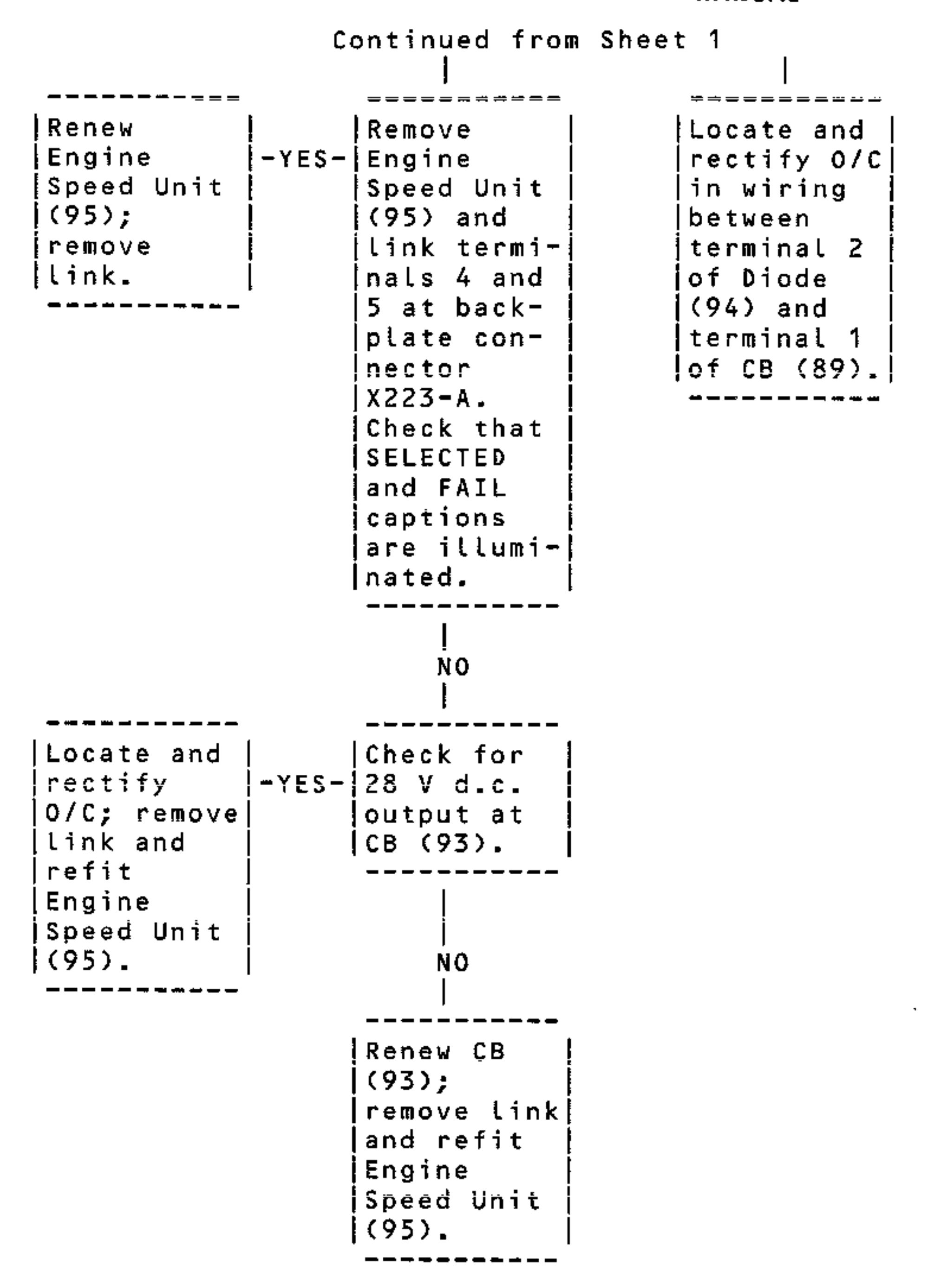


Chart 112 (Sheet 2 of 2)

'SELECTED' AND 'FAIL' CAPTIONS ILLUMINATED WITH THE EMERGENCY GENERATOR MODE SWITCH SET TO 'AUTO'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

CAUTION: WHEN REMOVING/REPLACING THE WEIGHT SWITCH OPERATED RELAYS CARE MUST BE TAKEN TO ENSURE THAT ALL SERVICES ADVERSELY AFFECTED BY INTERRUPTING THE WEIGHT SWITCH SERVICES ARE PREVIOUSLY ISOLATED (REF. 7-11-00).

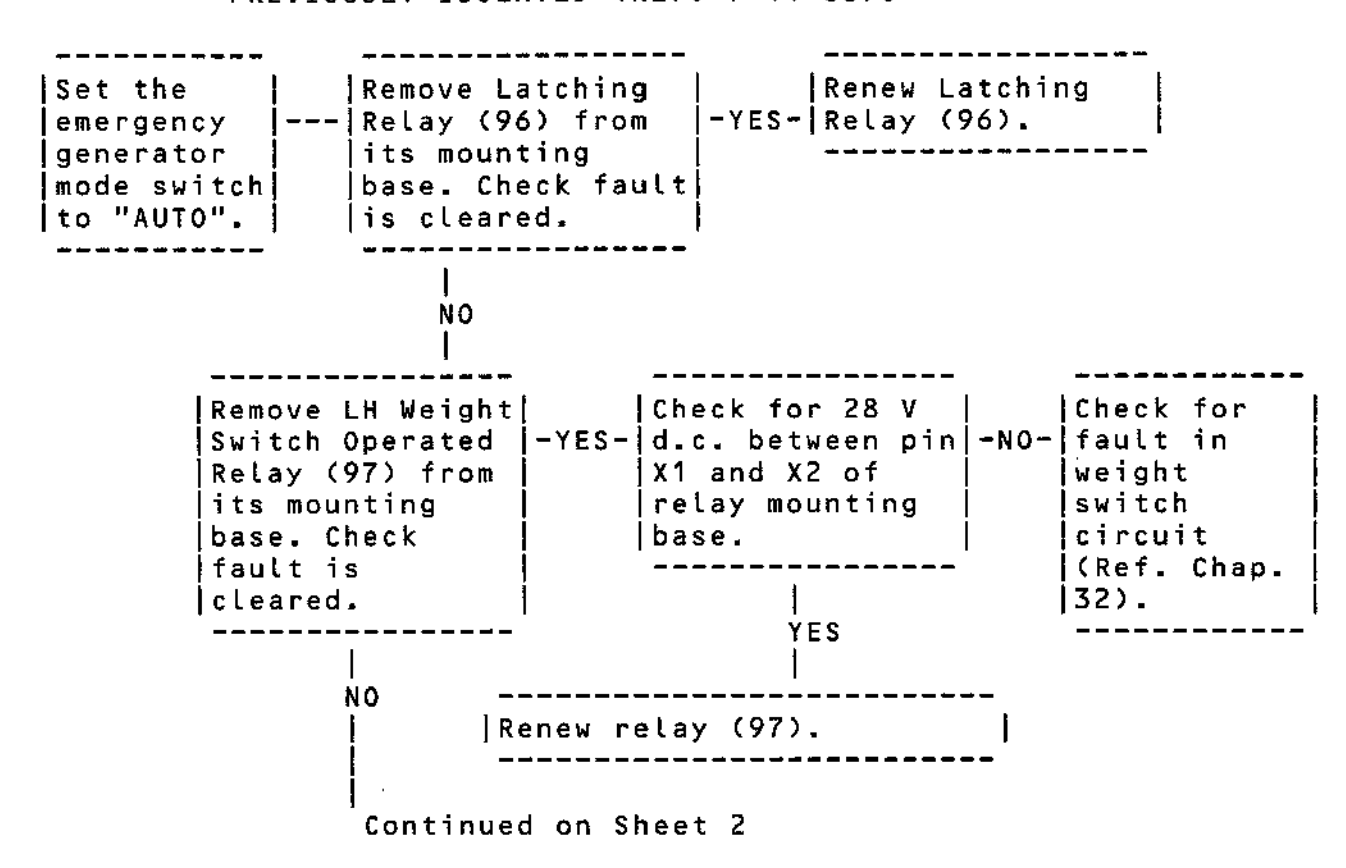


Chart 113 (Sheet 1 of 2)

Continued from Sheet 1

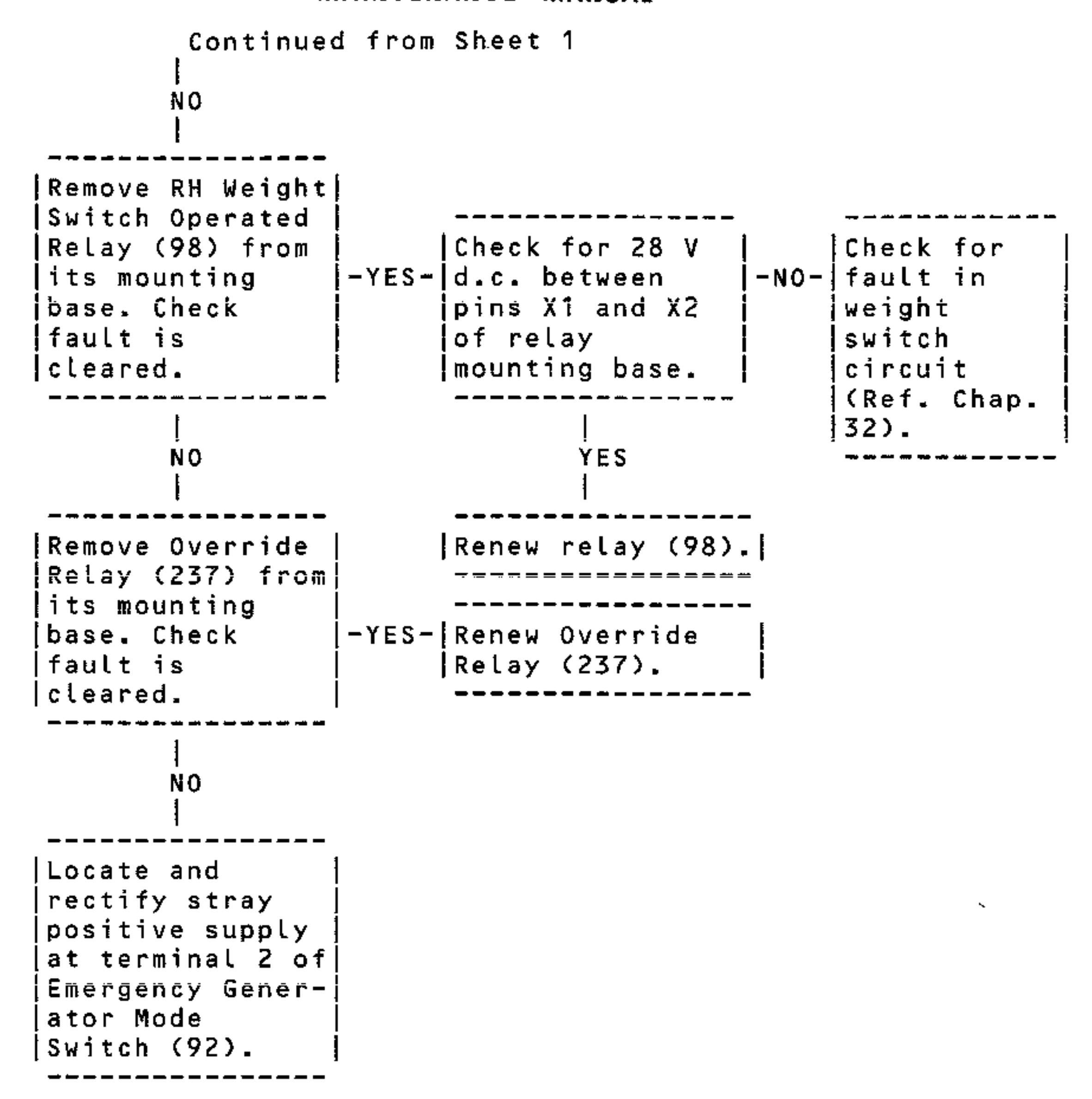


Chart 113 (Sheet 2 of 2)

```
*******************************           ---------------------------------
*'ISOL' SECTION OF 'A' OR 'B' *          |GROUND EQUIPMENT REQUIRED        |
*SYSTEM 'BATT - FAIL/ISOL'    *          |---------------------------------|
*CAPTION REMAINS EXTINGUISHED *          |DESCRIPTION            PART NO.  |
*WITH ASSOCIATED BATTERY      *          |---------------------------------|
*CONTROL SWITCH SET TO 'OFF'. *          |GROUND POWER SUPPLY    -         |
*******************************          |MULTIMETER             -         |
                                          ---------------------------------

 --------     ----------------      -------------       -----------
|Set     |   |Check that      |    |Disconnect 28|     |Renew      |
|battery |===|Battery Isolate |-NO-|V d.c. supply|-NO-|Battery    |
|control |   |Magnetic        |    |from coil of |     |Isolate    |
|switch  |   |Indicator (7) or|    |Battery      |     |Contactor  |
|to      |   |(8) displays    |    |Isolate      |     |(5) or     |
|"OFF".  |   |cross-line.     |    |Contactor    |     |(6).       |
 --------     ----------------     |(5) or (6),  |      -----------
                      |            |e.g. at      |
                      |            |terminal 1 of|
                      |            |CB (11) or   |
                     YES           |(12). Check  |
                      |            |that ISOL    |
                      |            |section of   |
                      |            |BATT - FAIL/ |
                      |            |ISOL Caption |
                      |            |Light Module |
                      |            |(3) or (4)   |
                      |            |is illumi-   |
                      |            |nated.       |
                      |             -------------
                      |                  |
                      |                 YES
                      |                  |
                      |             ----------------
                      |            |Renew Battery   |
                      |            |Control Switch  |
                      |            |(9) or (10).    |
                      |             ----------------
                      |
```

Continued on Sheet 2

Chart 114 (Sheet 1 of 2)

Continued from Sheet 1

```
Continued from Sheet 1
          |
 ------------------
|Check for 28 V    |        ----------------
|d.c. at terminal  |       |*Renew Battery   |
|11 of Battery     |-NO-   |Isolate          |
|Isolate Contactor |       |Contactor (5)    |
|(5) or (6).       |       |or (6).          |
 ------------------         ----------------
          |
         YES
          |
 ----------------------
|Check for 28 V d.c. at|    ----------------
|terminal 3 of BATT -  |-NO-|*Renew Battery  |
|FAIL/ISOL Caption     |    |Control Switch  |
|Light Module (3) or   |    |(9) or (10).    |
|(4).                  |     ----------------
 ----------------------
          |
         YES
          |
 ----------------------
|Renew BATT - FAIL/ISOL|
|Caption Light Module  |
|(3) or (4).           |
 ----------------------
```

Chart 114 (Sheet 2 of 2)

ASB POSITION MAGNETIC INDICATOR REMAINS CROSS-LINE WHEN EMERGENCY GENERATOR MODE SWITCH IS SET TO 'GRD BY-PASS' WITH NO.1 OR NO.2 ENGINE HP RPM (N2) INDICATOR READING APPROXIMATELY 65 PER CENT N2.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
------------------    -------------------          ----------------
|Set emergency     |   |Check for 28 V d.c.|        |*Renew Engine   |
|generator mode    |---|at terminal 1 of   |--NO-|Speed Unit (95).|
|switch to "GRD BY-|   |ASB (100).         |        ----------------
|PASS". Ensure that|    -------------------
|a reading of      |             |
|approximately     |            YES
|65 per cent N2 is |             |
|given on the      |    -------------------          ----------------
|appropriate (No.1 |   |Check for 28 V d.c.|        |*Renew ASB      |
|or No.2) engine   |   |at terminal 2 of   |-YES-|Position        |
|HP rpm (N2)       |   |ASB (100).         |        |Magnetic Indi-  |
|indicator.        |    -------------------         |cator (101).    |
------------------              |                    ----------------
                               NO
                                |
                        -------------------
                       |Renew ASB (100).   |
                        -------------------
```

Chart 115

```
********************************
*ESSENTIAL/MAIN ISOLATE        *
*MAGNETIC INDICATOR REMAINS    *
*IN-LINE WHEN ASSOCIATED       *
*ESSENTIAL/MAIN (NORM/EMERG)   *
*CONTROL SWITCH IS SET TO      *
*'EMERG' WITH EMERGENCY        *
*GENERATOR MODE SWITCH SET     *
*TO 'GRD BY-PASS' AND NO.1 OR  *
*NO.2 ENGINE HP RPM (N2)       *
*INDICATOR READING             *
*APPROXIMATELY 65 PER CENT N2. *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------     ------------     ------------     -----------
|Set the    |   |Check for 28|   |Check for 28|   |Locate and |
|essential/ |---|V d.c. at   |-YES-|V d.c. at |-YES-|rectify  |
|main (NORM/|   |terminal 11 |   |terminal X1 |   |stray posi-|
|EMERG)     |   |of Essential|   |of Essential|   |tive supply|
|control    |   |/Main       |   |/Main       |   |at terminal|
|switch to  |   |Change-over |   |Change-over |   |X1.        |
|"EMERG".   |   |Contactor   |   |Contactor   |    -----------
 -----------    |(54),(55),  |   |(54),(55),  |
                |(56) or (57)|   |(56) or (57)|
                 ------------     ------------
                      |                |
                      NO               NO
                      |                |
               --------------    --------------
              |Renew         |  |Renew         |
              |Essential/Main|  |Essential/Main|
              |Isolate       |  |Change-over   |
              |Magnetic      |  |Contactor     |
              |Indicator (58)|  |(54),(55),(56)|
              |(59),(60) or  |  |or (57).      |
              |(61).         |   --------------
               --------------
```

Chart 116

```
*******************************
*BOTH 26 V AC 'A' MAIN AND    *
*ESSENTIAL BUSBARS 'DEAD' OR  *
*BOTH 26 V AC 'B' MAIN AND    *
*ESSENTIAL BUSBARS 'DEAD' WITH*
*GROUND POWER SWITCHED ON.    *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------      -----------      --------------
|Switch on  |    |Check for  |    |Locate and    |
|ground     |---|26 V a.c.  |-YES-|rectify O/C   |
|power;     |    |output at  |    |between Trans-|
|ensure that|    |Transformer|    |former (109) or|
|the essen- |    |(109) or   |    |(110), and Load|
|tial main  |    |(110).     |    |Shed Contactor|
|(NORM/     |     -----------     |(107) or (108).|
|EMERG)     |          |           --------------
|control    |          NO
|switches   |          |
|are set to |     -------------      --------------       ---------
|NORM.      |    |Check for 115|-YES-|Check that    |-YES-|Renew    |
 -----------     |V a.c. input |    |earth return  |     |Trans-   |
                 |at Trans-    |    |circuit at    |     |former   |
                 |former (109) |    |Transformer   |     |(109) or |
                 |or (110).    |    |(109) or (110)|     |(110).   |
                  -------------     |is complete.  |      ---------
                        |            --------------
                        NO                  |
                        |                   NO
                        |                   |
                        |            --------------
                        |           |Rectify O/C.  |
                        |            --------------
                  -------------
                 |Check for 115|     --------------
                 |V a.c. output|    |Locate and    |
                 |at CB (105)  |-YES-|rectify O/C in|
                 |or (106).    |    |supply line to|
                  -------------     |Transformer   |
                        |           |(109)or       |
                        NO          |(110).        |
                        |            --------------
                  -------------
                 |Renew CB     |
                 |(105) or     |
                 |(106).       |
                  -------------
```

Chart 117

END OF THIS SECTION

NEXT

```
******************************
*26 V AND 115 V AC STANDBY   *
*BUSBARS REMAIN 'DEAD' WITH  *
*GROUND POWER ON AND LEFT-HAND*
*'RAT' CONTROL SWITCH SET TO *
*'TEST'.                     *
******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renwal of components (*), check the associated wiring for continuity.

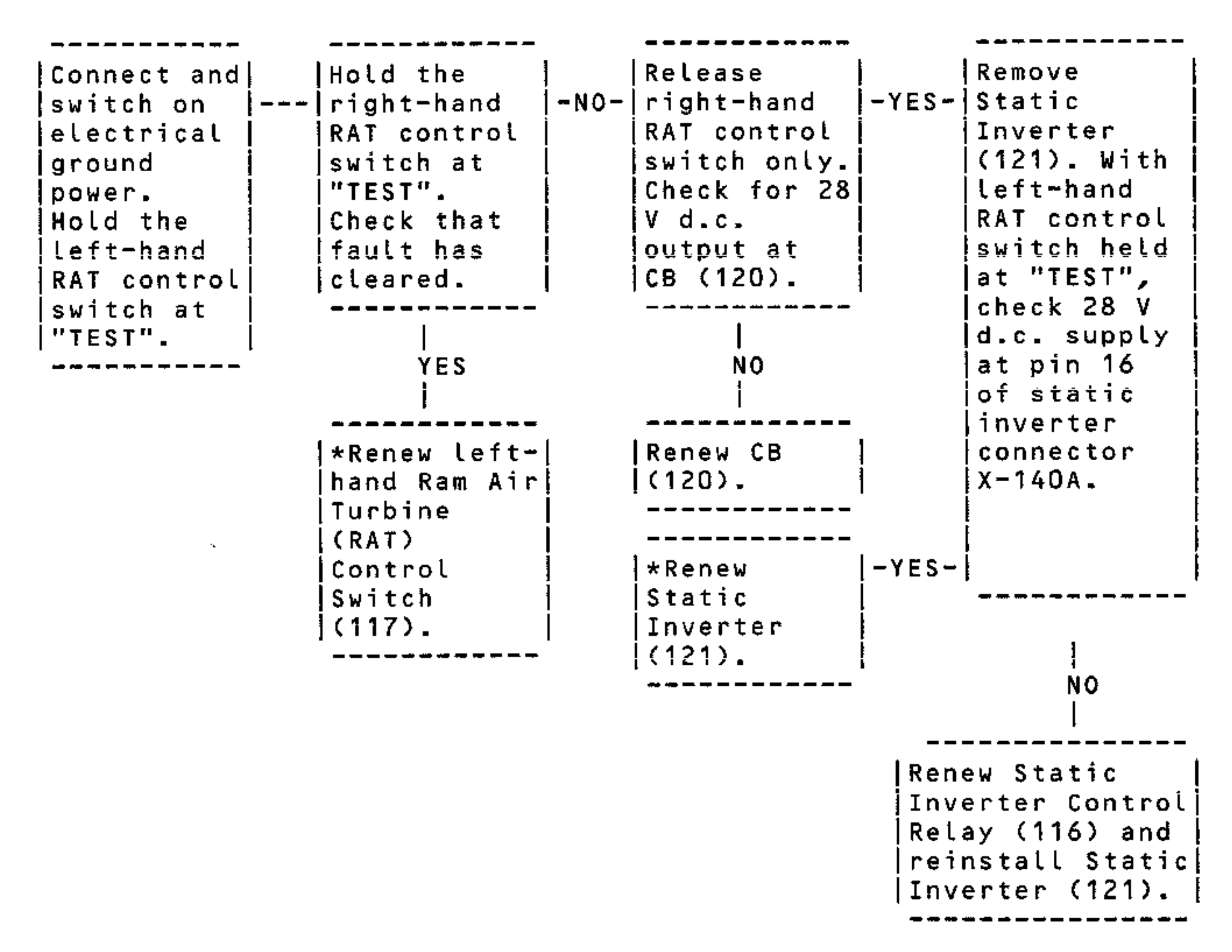


Chart 118

WITH DORMANT CIRCUIT TEST SET SWITCH S1 SET TO POSITION '7' AND THE GCB CONTROL SWITCH SET TO 'ON', THE ASSOCIATED GCB POSITION MAGNETIC INDICATOR REMAINS CROSS-LINE.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

On the test set, set S1 to position "7", all other switches to "1" and the 28 V supply switch to "ON". Check that the associated GCB Control Switch (183),(184) (185) or (186) is set to ON.

Check for 28 V d.c. at terminal 1 of the appropriate TB: TB UG2865 on shelf 24-215 (channel 1); TB UG2870 on shelf 24-215 (channel 2); TB UG812 on shelf 24-216 (channel 3); or TB UG2817 on shelf 24-216 (channel 4).

- YES → Check for 28 V d.c. at terminal A of GCB Position Magnetic Indicator (169),(170), (171) or (172).
  - YES → *Renew GCB Position Magnetic Indicator (169), (170), (171) or (172).
  - NO → *Renew Generator Circuit Breaker (GCB) (177), (178) (179) or (180).
- NO → Continued on Sheet 2

Chart 119 (Sheet 1 of 2)

Continued from Sheet 1

NO

Renew the CPU (183), (184),(185) or (186) and repeat the Dormant Circuits Functional Test for the affected channel (Ref. para. 11.).	-YES-	Disconnect the test set and remove the Control and Protection Unit (CPU) (128), (129), (130) or (131). With the associated generator control switch set to ON, check continuity between pin 21 of the CPU rack connector and terminal 1 of the appropriate TB: TB UG2865, TB UG2870 TB UG2812 or TB UG2817.	-NO-	Locate and rectify O/C. If O/C is at switch terminals, renew Generator Control Switch (183), (184), (185) or (186). Refit CPU (128). (129), (130) or (131) and repeat the Dormant Circuits Functional Test for the affected channel (Ref. para.11.).

Chart 119 (Sheet 2 of 2)

AN ENGINE RELIGHT BUSBAR 'POWER ON' NEON INDICATOR REMAINS OUT WITH POWER ON AND 'EMERG RELIGHT BUSBAR' SELECTOR SWITCH SET TO 'OFF'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

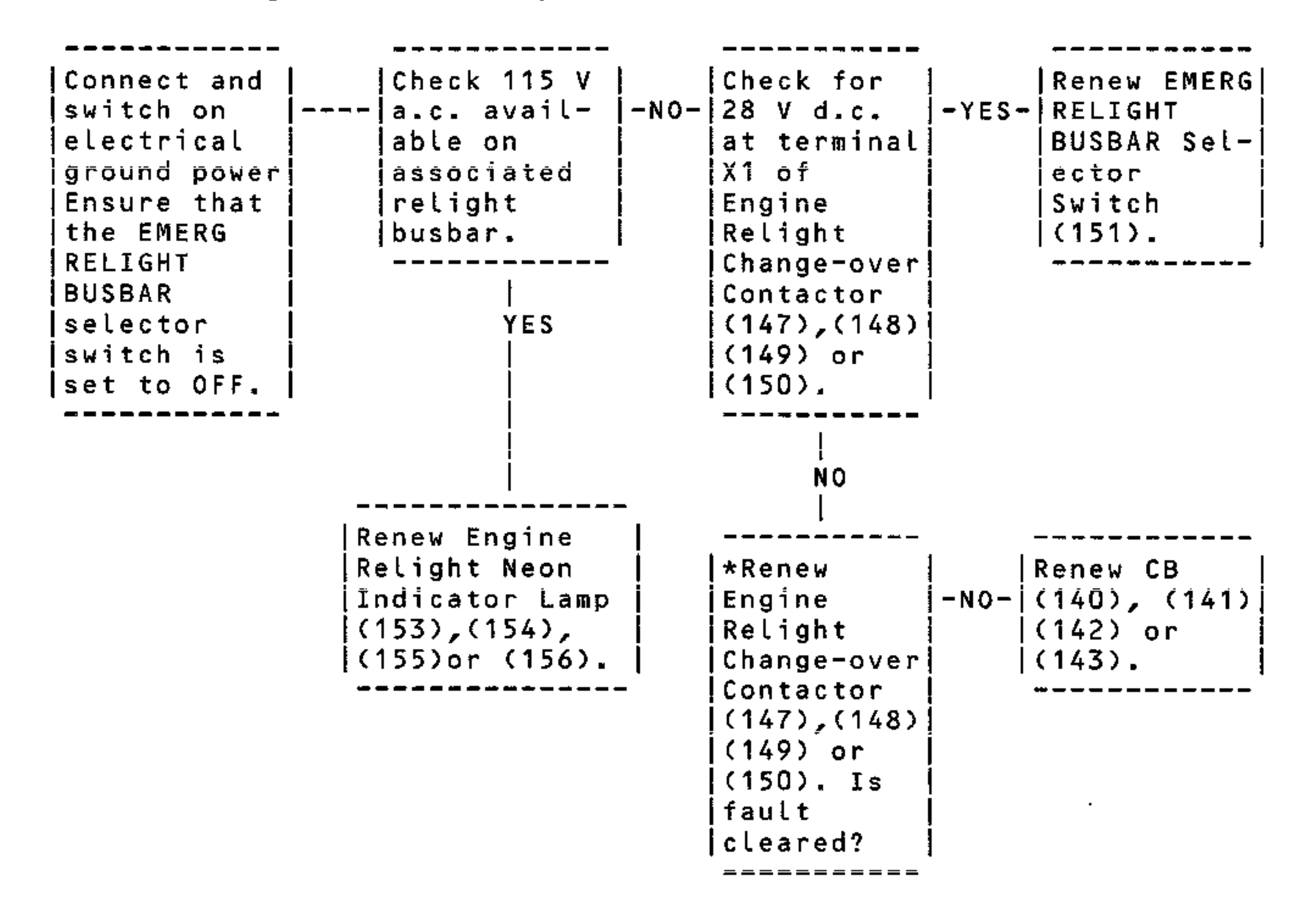


Chart 120

R **ON A/C 007-007,

VOLTAGE AND FREQUENCY NOT INDICATED AND NEON INDICATOR LAMP OUT, WITH EMERGENCY GENERATOR 'FAIL' AND 'SELECTED' CAPTIONS ILLUMINATED, AC FREQ/VOLTS SELECTOR SWITCH SET TO 'EMERG PWR', EMERGENCY GENERATOR MODE SWITCH SET TO 'MANUAL' AND NOS.1 AND 2 'NORM/EMERG' CONTROL SWITCHES SET TO 'EMERG'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-
GROUND HYDRAULIC SUPPLY	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Connect and switch on electrical ground power; pressurize green hydraulic system (Ref. Chap.29). Set the AC FREQ/VOLTS selector switch to "EMERG PWR", the emergency generator mode switch to "MANUAL" and Nos.1 and 2 NORM/EMERG control switches to "EMERG".

Press-to-test the emergency generator FAIL caption. Check that fault has cleared.

- YES: Check the fault indicators on the Emergency Generator Control and Protection Unit (CPU) (88); See NOTE on Sheet 3.
- NO: Check that the Emergency Generator (162) is rotating.
  - YES: Continued on Sheet 2
  - NO: Set emergency generator mode switch to "AUTO" and then back to "MANUAL" while listening for operation of the Emergency Generator Hydraulic Selector Valve (152).
    - YES: Renew Emergency Generator and Drive Unit (162).
    - NO: Continued on Sheet 2

8

Chart 121 (Sheet 1 of 3)

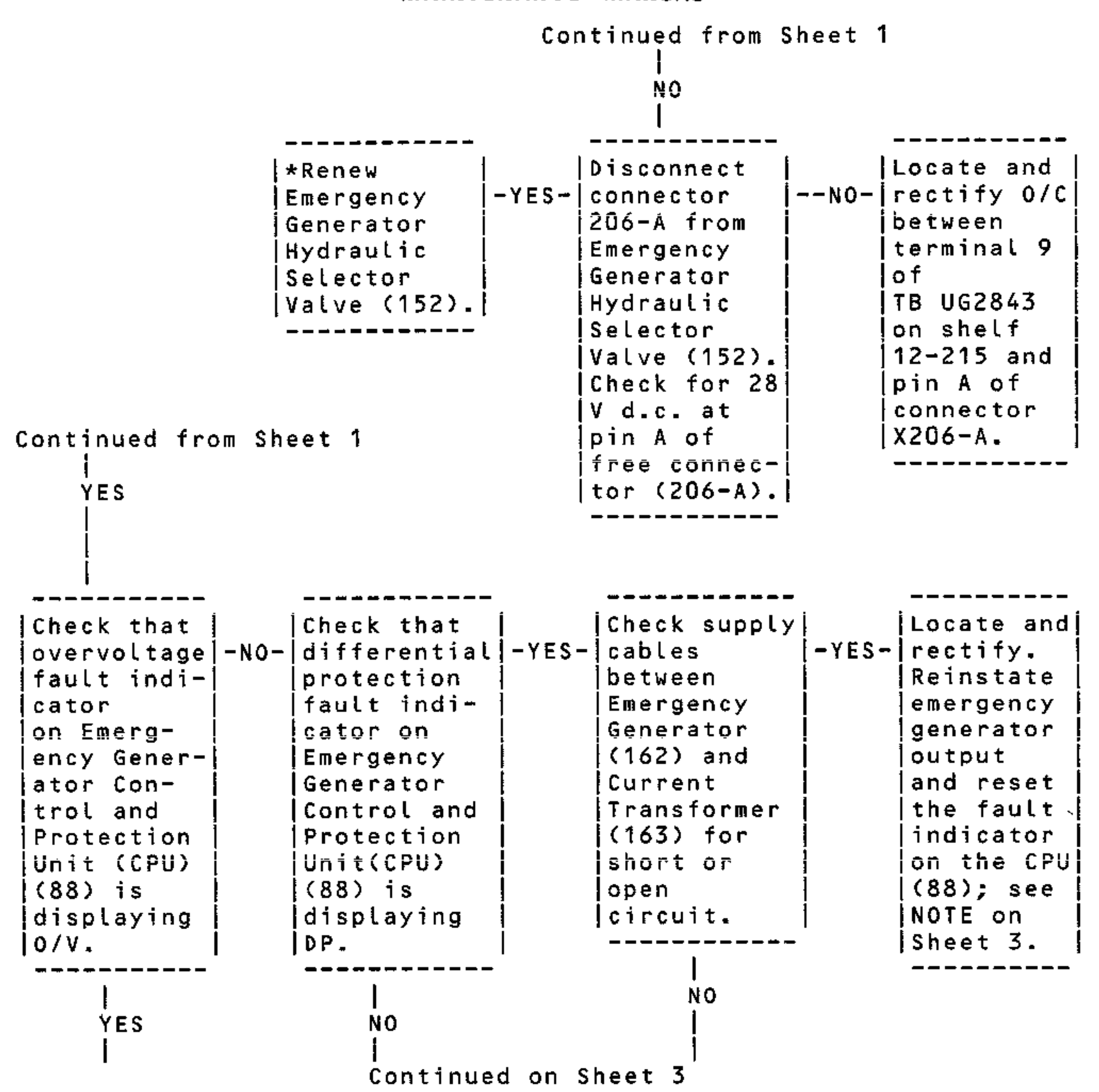
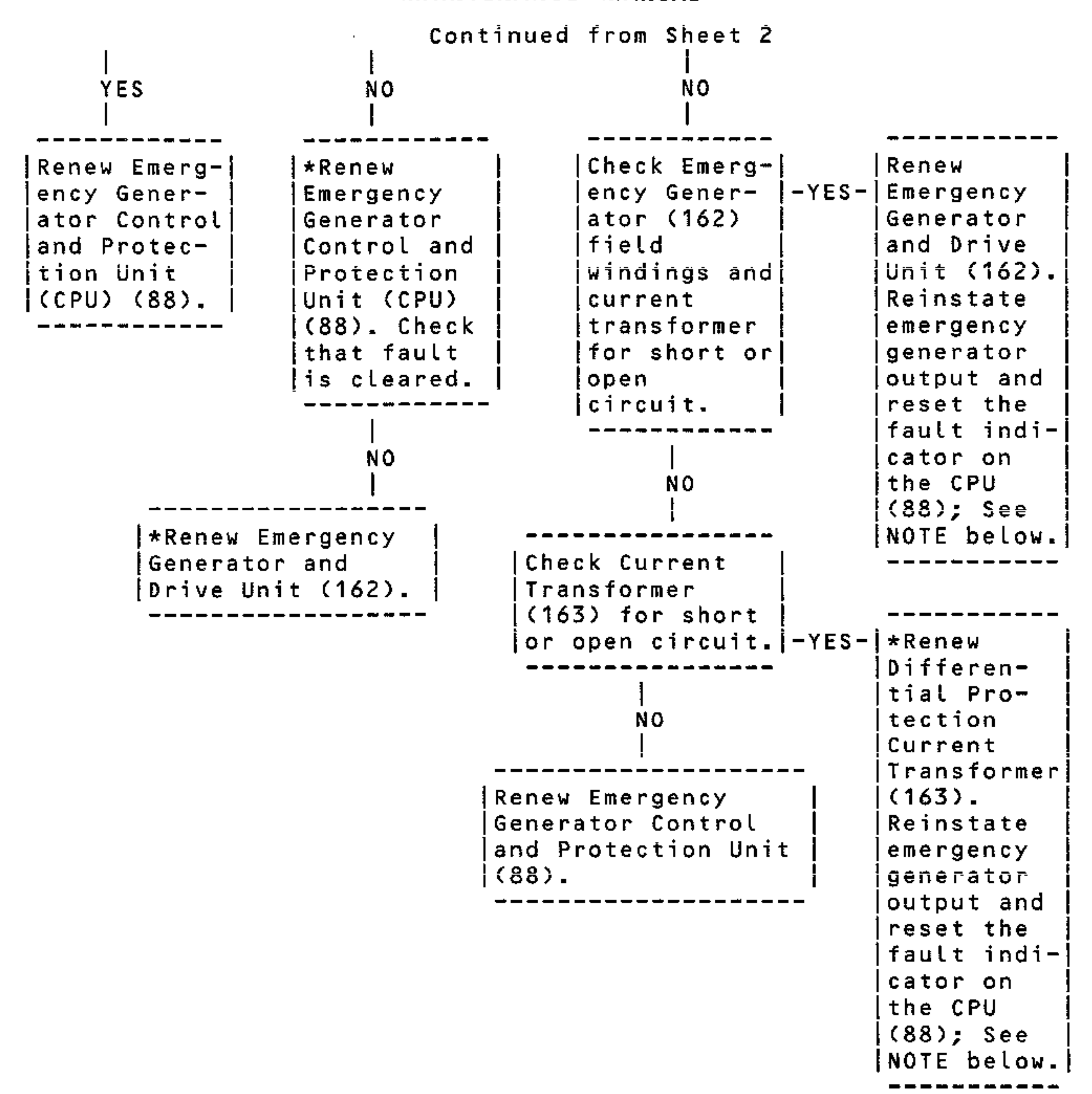


Chart 121 (Sheet 2 of 3)



NOTE: With the emergency generator running on test after clearance of an O/V or DP fault, the FAIL caption must be pressed-to-test (CPU reset) to reinstate the generator output, and the fault indicator on the CPU (88) must be reset by insertion of a suitable probe through the CPU front panel to activate the appropriate reset microswitch, SW1 (O/V) or SW5 (DP).

Chart 121 (Sheet 3 of 3)

****
*A 'GEN' FAILURE CAPTION *
*REMAINS EXTINGUISHED WITH *
*ELECTRICAL GROUND POWER *
*AVAILABLE AND ASSOCIATED *
*ENGINE STOPPED. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Connect and switch on electrical ground power with all engines stopped.
→ Check for 28 V d.c. at terminal 2 of GEN Caption Light Module (173), (174), (175) or (176).
- NO → *Renew GCB (177), (178), (179) or (180).
- YES → *Renew GEN Caption Light Module (174) (175) or (176).

Chart 122

```
********************************
*A "CSD' FAILURE CAPTION       *
*REMAINS EXTINGUISHED WITH     *
*ELECTRICAL GROUND POWER       *
*AVAILABLE AND ENGINES         *
*STOPPED.                      *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 --------     ----------------     --------------     --------
|Connect |   |Press-to-test   |   |Disconnect the|   |Renew   |
|and     |---|the extinguished|-YES-|electrical    |-YES-|IDG Oil |
|switch  |   |CSD failure cap-|   |connector from|   |Low     |
|on elec-|   |tion. Check that|   |the associated|   |Pressure|
|trical  |   |the caption is  |   |IDG oil low   |   |Warning |
|ground  |   |illuminated.    |   |pressure      |   |Switch  |
|power   |    ----------------    |warning switch|   |(191),  |
|with all|           |            |e.g., connec- |   |(192),  |
|engines |           NO           |tor 1X1C from |   |(193) or|
|stopped.|           |            |Switch (191)  |   |(194).  |
 --------     --------------      |(caption CSD  |    --------
             |Check for 28 V|     |1); connector |
             |d.c. output at|     |2X1C from     |
 --------    |appropriate   |     |switch (192)  |
|Locate  |   |supply CB:    |     |(caption CSD  |
|and     |-YES-|CB (187) (cap-|     |2); connector |
|rectify |   |tion CSD 2)   |     |3X1C from     |
|O/C.    |   |CB (188) (cap-|     |switch (193)  |
 --------    |tion CSD 1);  |     |(caption CSD  |
             |CB (189) (cap-|     |3); connector |
             |tion CSD 4);  |     |4X1C from     |
             |CB (190) (cap-|     |Switch (194)  |
             |tion CSD 3).  |     |(caption CSD  |
              --------------      |4). Link pins |
                     |            |A and B of the|
                     NO           |free connector|
                     |            |and check that|
              --------------      |the associated|
             |Renew CB (187)|     |CSD caption is|
             |(188), (189)  |     |illuminated.  |
             |or (190).     |      --------------
              --------------              |
```

Continued on Sheet 2

Chart 123 (Sheet 1 of 2)

Continued from Sheet 1

NO

Renew CSD Caption Light Module (195) (196), (197) or (198). Remove link from pins A and B of connector and reconnect to associated IDG oil low pressure warning switch. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, (20-42-48).	-YES-	Check for continuity of wiring between terminal 2 of CSD caption and earth via linked pins A and B of associated IDG oil low pressure warning switch 'free' connector.	-NO-	Locate and rectify O/C. Remove link from pins A and B of connector and reconnect to associated IDG oil low pressure warning switch. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

Chart 123 (Sheet 2 of 2)

WITH AN ENGINE RUNNING ABOVE A SPEED OF 62 PER CENT N2, THE ASSOCIATED 'CSD' FAILURE CAPTION REMAINS ILLUMINATED WITH THE ASSOCIATED 'GEN' FAILURE CAPTION EXTINGUISHED.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

Shut down all running engines (Ref. Chap. 71).

At the associated IDG (199),(200),(201) or (202), inspect the magnetic drain plug for evidence of contamination and the differential pressure indicators on the charge oil and scavenge filters for indication of filter blockage and take action as required (Ref. 24-11-11, Inspection/Check). Check that further running of the IDG is permitted by the Inspection/Check requirements.

-YES- Check that the IDG is is correctly filled and primed with oil (Ref. 24-11-11, Servicing). Check that the transmission is engaged, by pulling the disconnect reset handle at the bottom of the IDG. Start and run the associated engine at a speed above 62 per cent N2, (Ref. Preparation, para.2.M., and 71-00-00). Check that fault has cleared.

NO (from the IDG inspection box)

NO (from the fault cleared check box)

Continued on Sheet 2

Chart 124 (Sheet 1 of 2)

Continued from Sheet 1

NO

Renew IDG (199),(200),(201) or (202).

NO

Shut down the associated engine (Ref. Chap.71). Disconnect the electrical connector from the associated IDG oil low pressure warning switch, e.g., connector 1X1C from Switch (191) (caption CSD 1); connector 2X1C from Switch (192)(caption CSD 2); connector 3X1C from Switch (193) (caption CSD 3); connector 4X1C from Switch (194) (caption CSD 4). Check that the associated CSD caption is extinguished.

-YES-

Renew the associated IDG Oil Low Pressure Warning Switch (191),(192),(193) or (194). Start and run the associated engine at a speed above 62 per cent N2 (Ref. Preparation, para.2.M., and 71-00-00). Check that fault has cleared.

NO

Renew IDG (199), (200),(201) or (202).

NO

Locate and rectify stray earth between terminal 2 of CSD Caption Light Module (195), (196), (197) or (198) and associated IDG oil low pressure switch 'free' connector. Refit the connector. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

Chart 124 (Sheet 2 of 2)

```
*******************************
*WITH ANY ONE ENGINE RUNNING  *
*ABOVE A SPEED OF 62 PER CENT *
*N2, THE ASSOCIATED 'GEN'     *
*FAILURE CAPTION REMAINS      *
*ILLUMINATED WITH THE ASSOCI- *
*ATED GCB POSITION MAGNETIC   *
*INDICATOR DISPLAYING CROSS-  *
*LINE.                        *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-
DORMANT CIRCUIT TEST SET	TE 5002000

NOTE: Before renewal of components (*), check the associated wiring for continuity.

With the engine running at a speed above 62 per cent N2 set the AC FREQ/VOLTS selector switch to "GEN 1, 2, 3 or 4", as appropriate and hold the associated generator control switch at "TEST". Check and record indicated generator output voltage and frequency.

→ Check that the indicated output of the generator is correct, i.e., 115(+3 -5) V, 400(±4) Hz.

- YES → Continued on Sheet 2
- NO → Continued on Sheet 2

Chart 125 (Sheet 1 of 4)

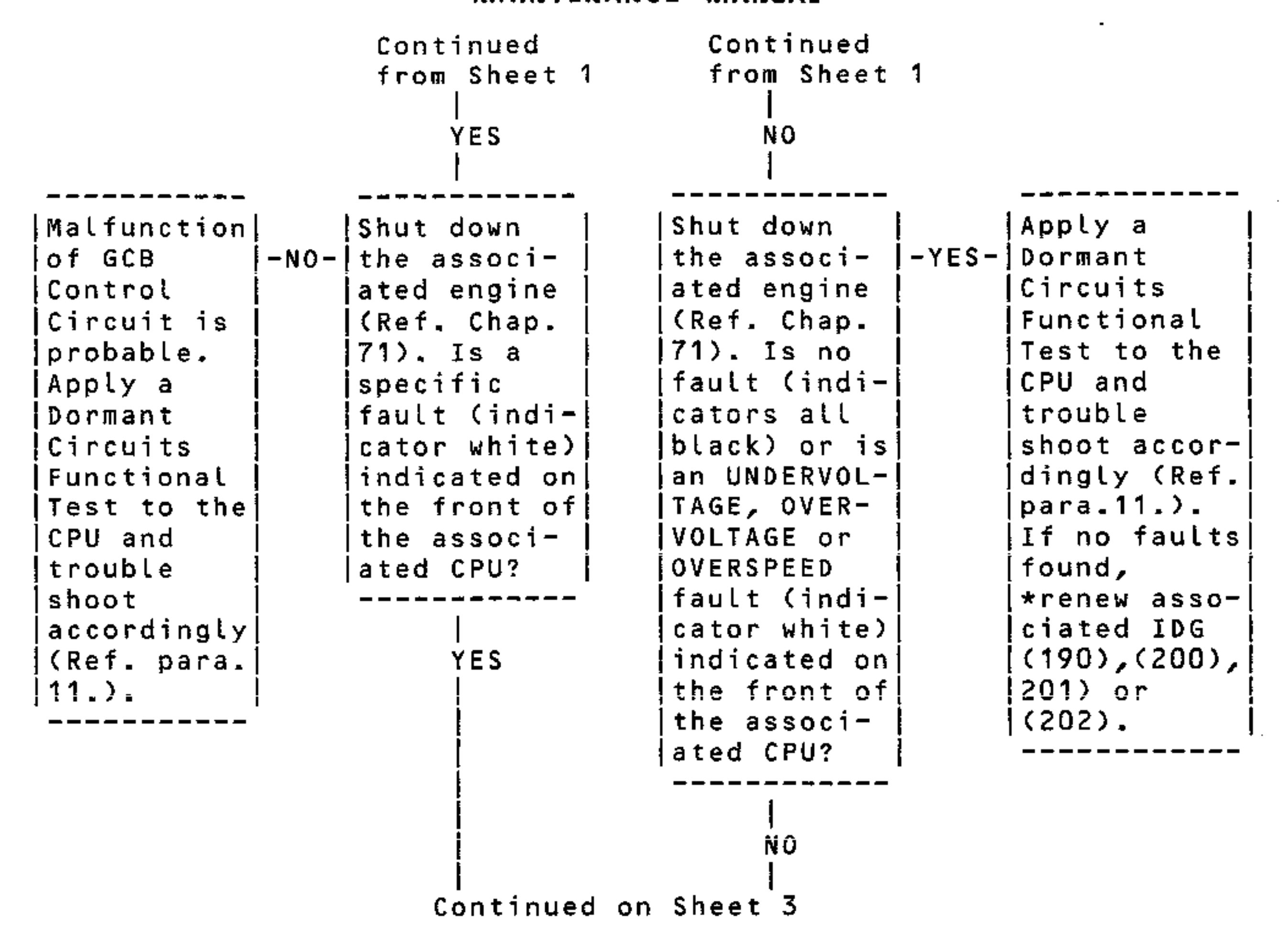


Chart 125 (Sheet 2 of 4)

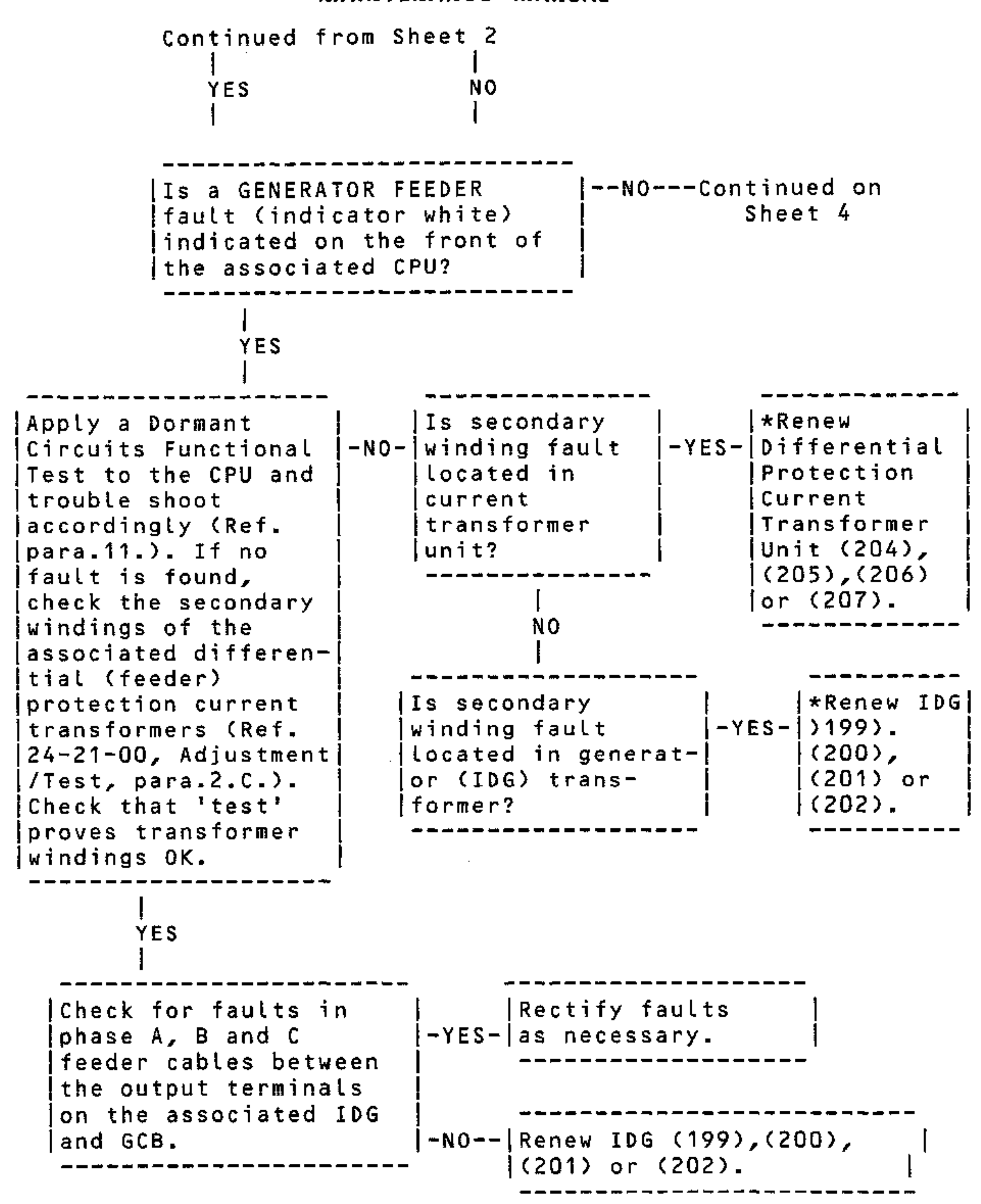


Chart 125 (Sheet 3 of 4)

```
                     ----------------------------
Continued-------|Is a BUSBAR fault (indicator |
from Sheet 3    |white) indicated on the front|
                |of the associated CPU?       |
                 ----------------------------
                              |
                             YES
                              |
       -------------------------------        -------------------
      |Apply a Dormant Circuits       |      |Renew faulty cables |
      |Functional Test to the CPU and |-YES-|as necessary.       |
      |trouble shoot accordingly (Ref.|       -------------------
      |para.11.). if no faults found, |
      |isolate the electrical genera- |
      |tion and external power        |
      |supplies (Ref. Servicing). In  |
      |each generation channel, check |
      |for faults in feeder cables    |
      |between the GCB and the        |
      |distribution busbars.          |
       -------------------------------
                  |
                  NO
                  |
       ------------------------------------------
      |*Renew the GCB (177),(178),(179) or (180).|
       ------------------------------------------
```

Chart 125 (Sheet 4 of 4)

****
*ASB POSITION MAGNETIC *
*INDICATOR REMAINS CROSS-LINE *
*WITH NO.1 ENGINE RUNNING *
*ABOVE A SPEED OF 62 PER CENT *
*N2. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Shut down No.1 engine (Ref. 71-00-00). Ensure that operation of the ASB has been checked and cleared in accordance with procedures detailed in paragraph 4., Emergency Generation - Preliminary.

→ Check the Engine Pulse Probe Unit (164) in accordance with the applicable test procedures (Ref. 71-50-00, Adjustment/Test. Check that the test requirements are met.

- YES → *Renew Engine Speed Unit (95). Check that fault is cleared.
  - NO → Renew Engine Pulse Probe Unit (164).
- NO → *Renew Engine Pulse Probe Unit (164).

Chart 126

****
*WITH TWO OR MORE ENGINES *
*RUNNING ABOVE A SPEED OF 62 *
*PER CENT N2, A 'GEN' *
*FAILURE CAPTION REMAINS *
*ILLUMINATED WITH THE ASSOCI- *
*ATED GCB POSITION MAGNETIC *
*INDICATOR DISPLAYING CROSS- *
*LINE. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-
DORMANT CIRCUIT TEST SET	TE 5002000

NOTE: Before renewal of components (*), check the associated wiring for continuity.

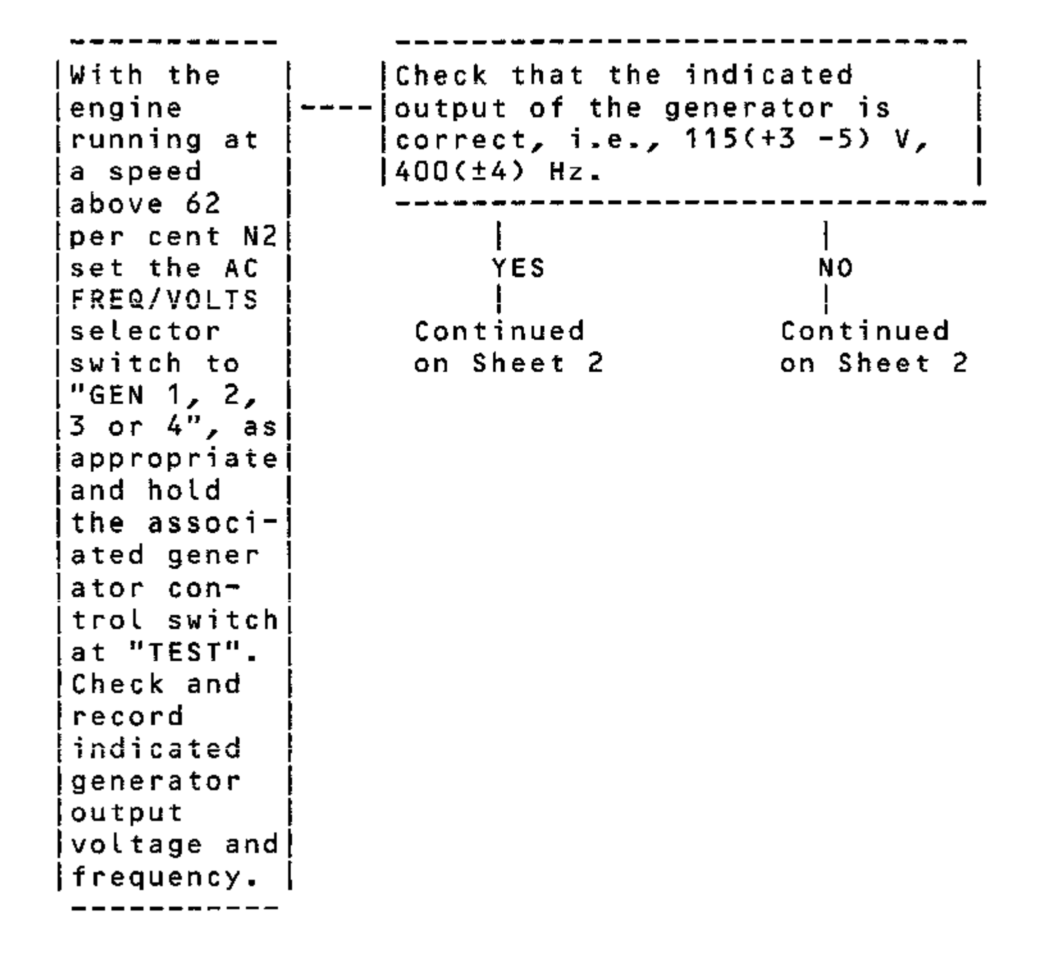


Chart 127 (Sheet 1 of 3)

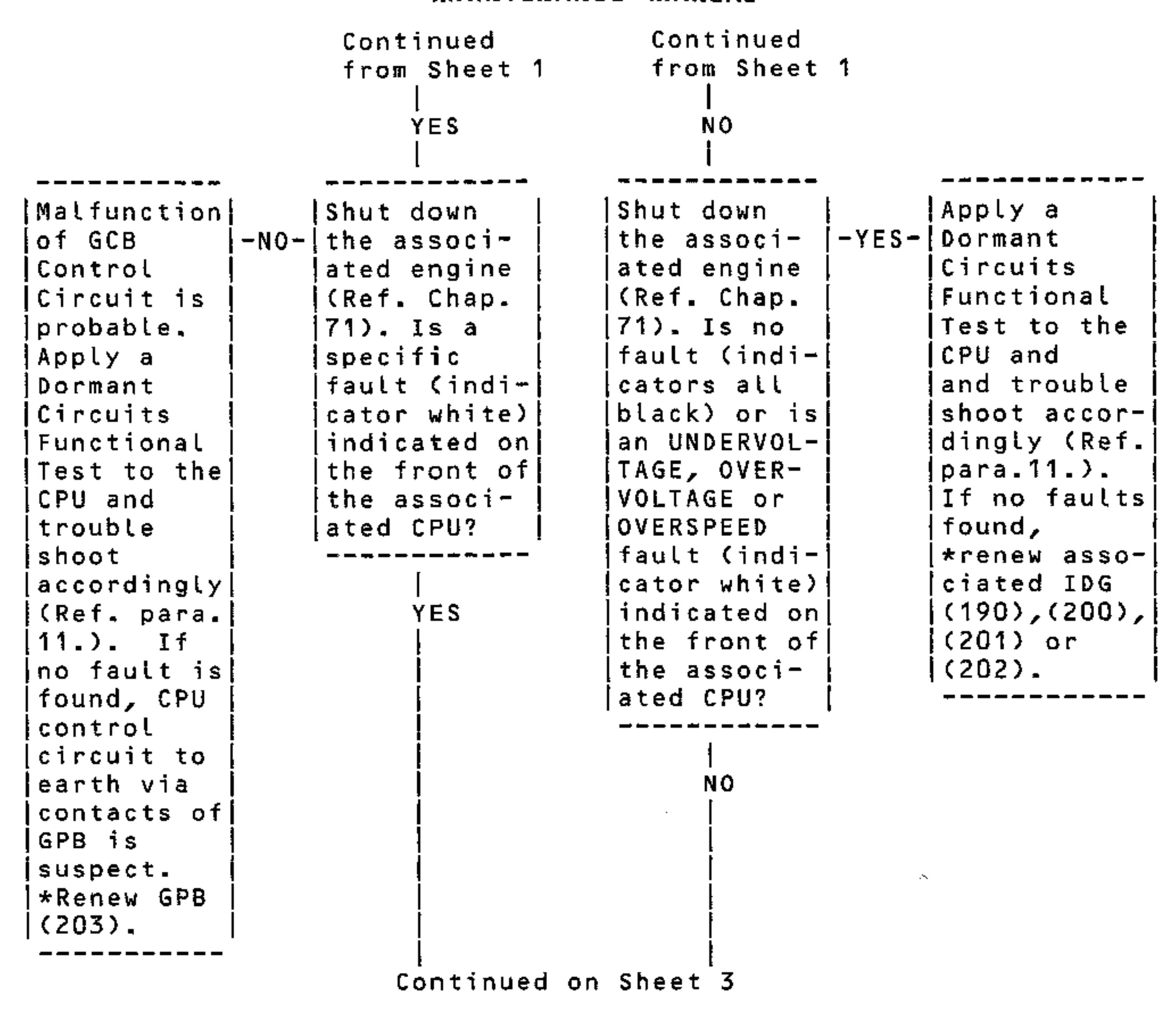


Chart 127 (Sheet 2 of 3)

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Continued from Sheet 2

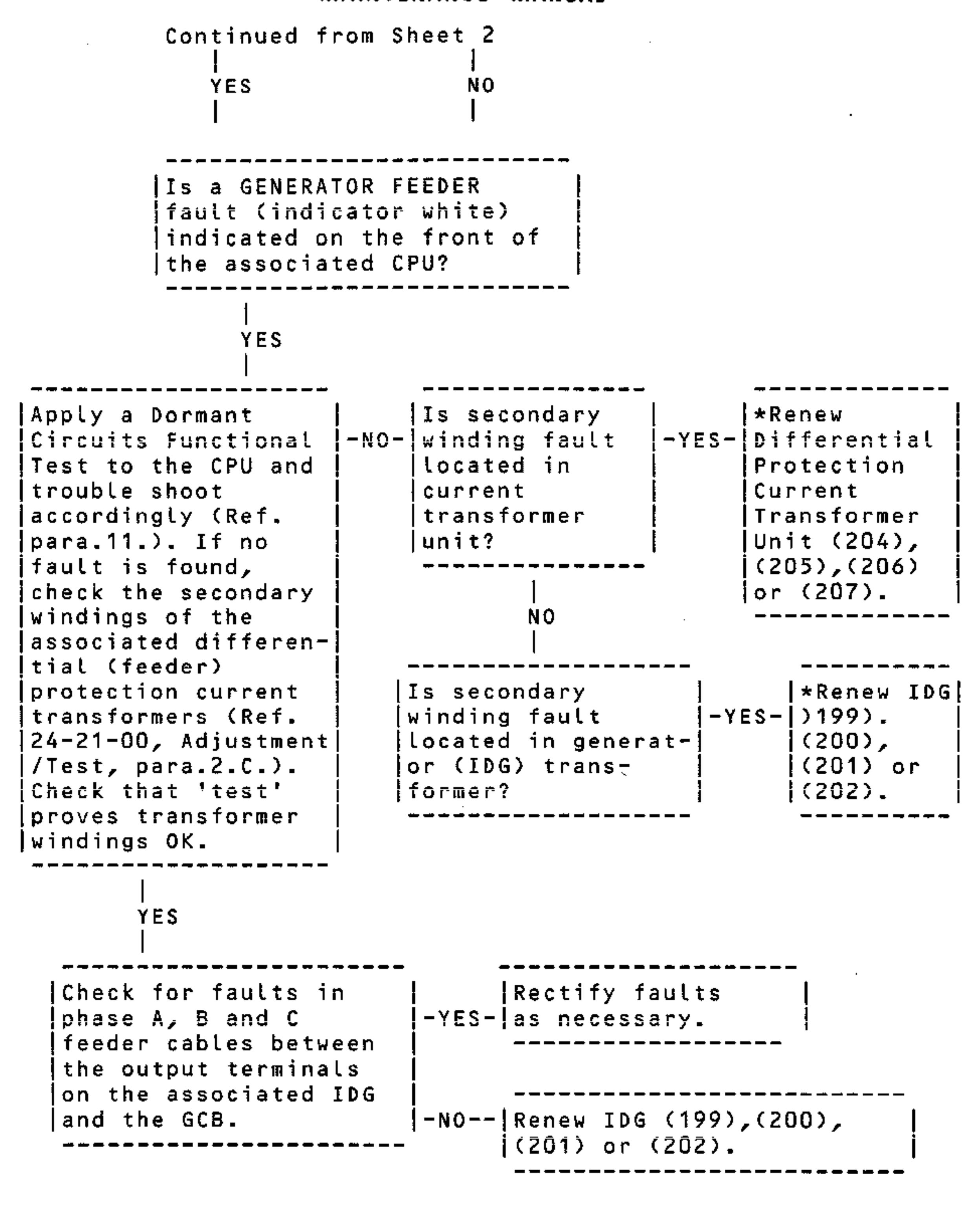


Chart 127 (Sheet 3 of 3)

```
********************************
*VOLTAGE AND FREQUENCY ARE NOT*
*DISPLAYED WHEN THE ASSOCIATED*
*GENERATOR IS SELECTED AT THE *
*AC FREQ/VOLTS SELECTOR SWITCH*
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

The associated checks on the initial application of electrical ground power prove the serviceability of the voltmeter and frequency meter (Ref. 24-41-00).

```
 -----------------      ------------------         ----------------
|Shut down the    |    |With the associated|      |Renew Circuit   |
|running engines  |----|generator selected |-YES-|Breaker (165),  |
|(Ref. Chap.71).  |    |on the AC FREQ/     |      |(166),(167), or |
 -----------------     |VOLTS selector      |      |(168).          |
                       |switch, check for   |       ----------------
                       |continuity between  |
                       |pin A of the a.c.   |
                       |test socket D116-A  |
                       |on panel 18-216 and|
                       |terminal A2 of the  |
                       |associated supply   |
                       |circuit breaker     |
                       |(165), (166),       |
                       |(167) or (168).     |
                        ------------------
                                 |
                                 NO
                                 |
                        --------------------
                       |*Renew AC FREQ/VOLTS|
                       |Selector Switch     |
                       |(161).              |
                        --------------------
```

Chart 128

R **ON A/C 007-007,

```
********************************
*WITH TWO OR MORE ENGINES      *
*RUNNING AT A SPEED ABOVE 62   *
*PER CENT N2, A BTB POSITION   *
*MAGNETIC INDICATOR DISPLAYS   *
*CROSS-LINE.                   *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	-
MULTIMETER	-
DORMANT CIRCUIT TEST SET	TE 5002000

NOTE: Before renewal of components (*), check the associated wiring for continuity.

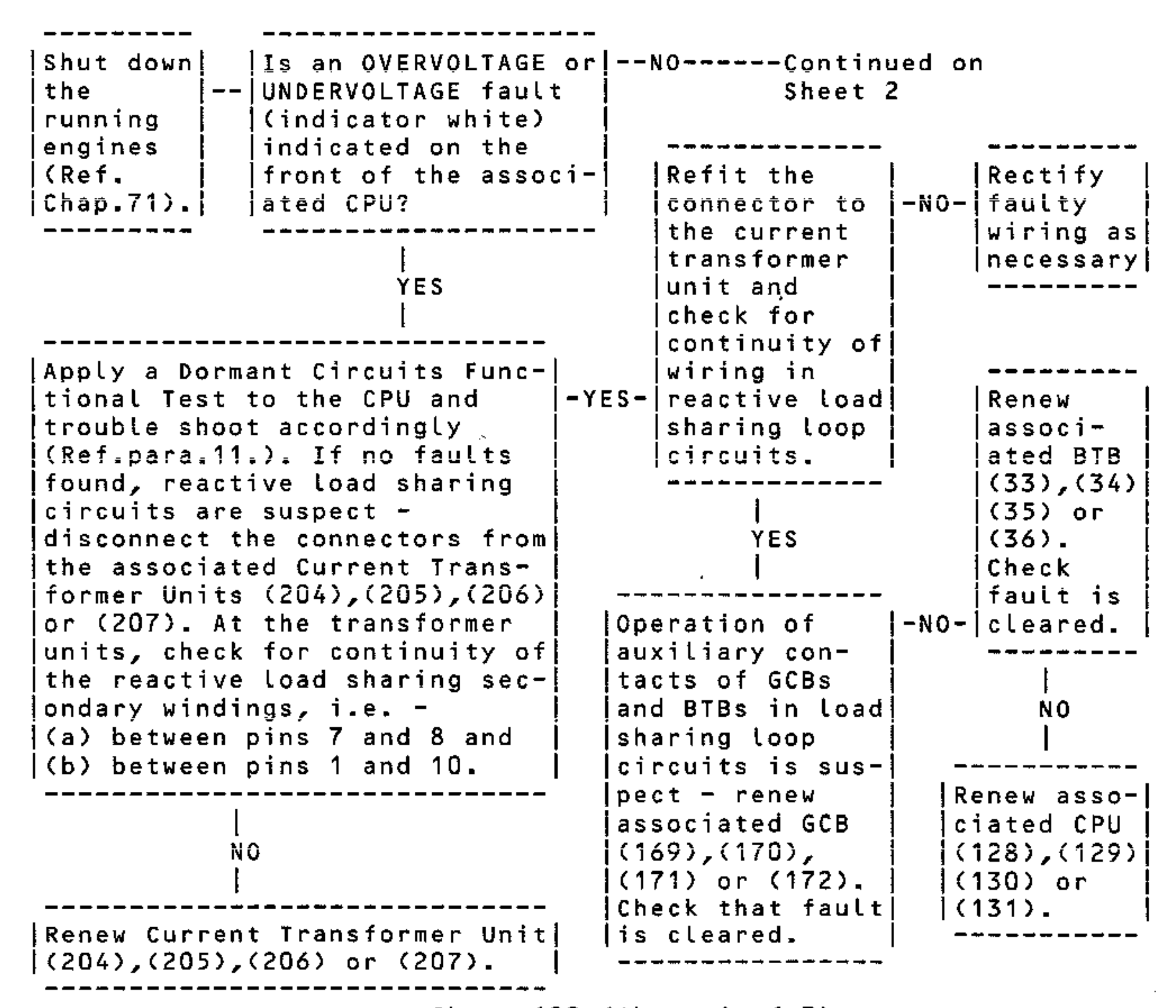


Chart 129 (Sheet 1 of 3)

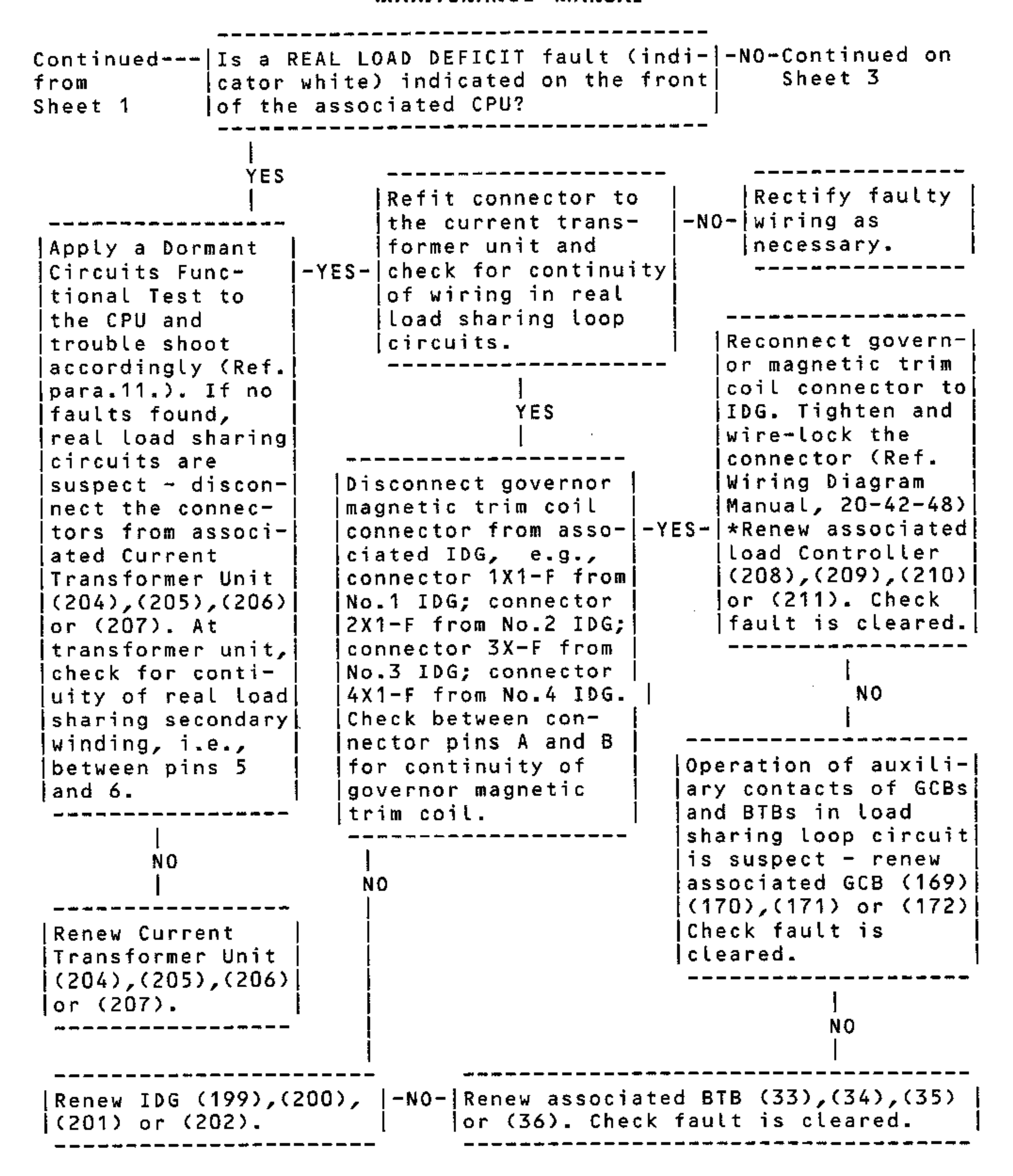


Chart 129 (Sheet 2 of 3)

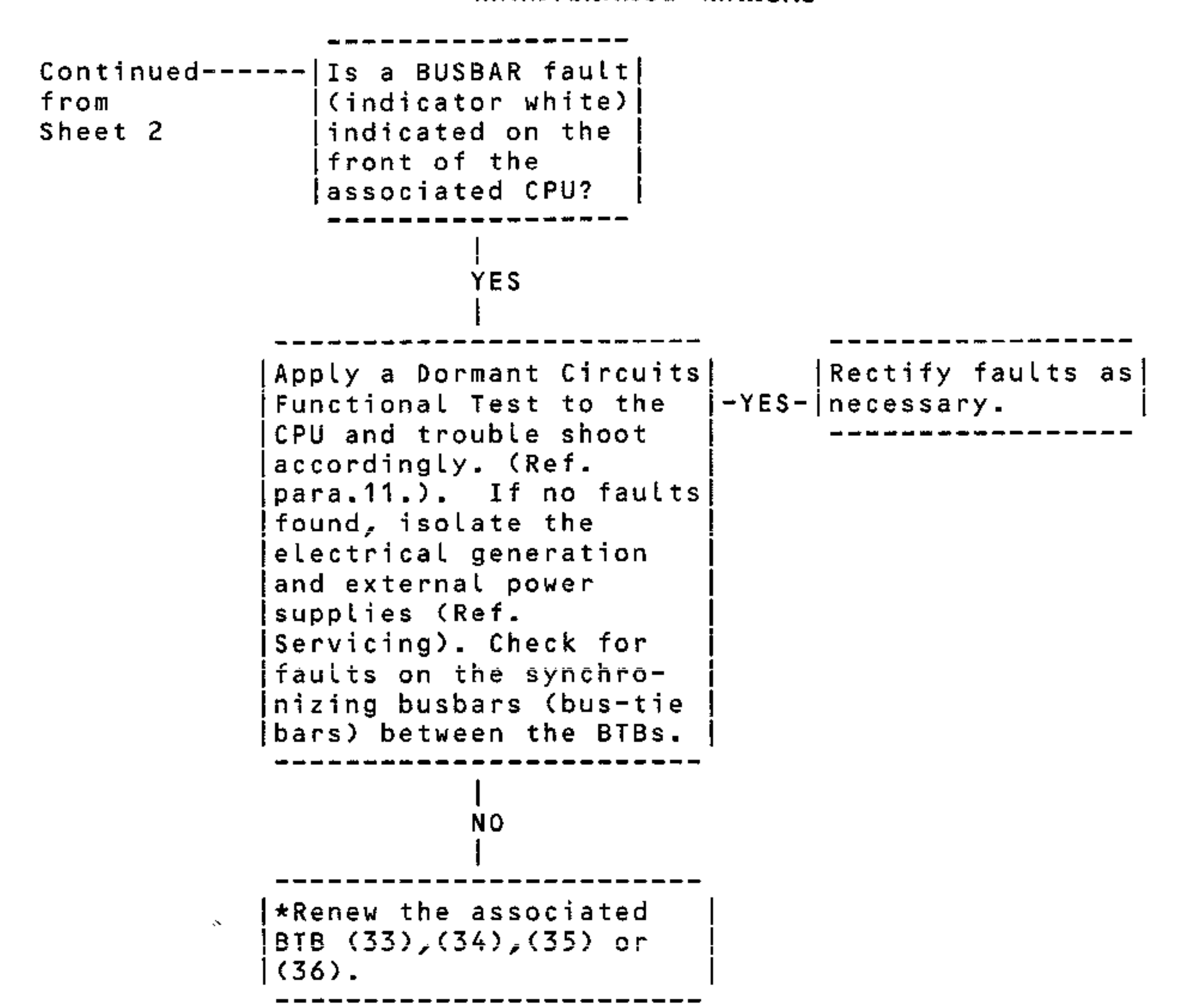


Chart 129 (Sheet 3 of 3)

```
********************************
*WITH THE ASSOCIATED GENERATOR*
*ON-LINE, A KW/KVAR METER     *
*GIVES ZERO 'KW' INDICATION   *
*('PUSH FOR KVAR' SWITCH      *
*RELEASED).                   *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 ---------------     ---------------      ---------
|Shut down the  |   |Check for con- |    |Check    |--YES-
|running engines|---|tinuity between|-YES-|earth    |  Continued
|(Ref. Chap.71).|   |pin E of the   |    |potential|  on Sheet 2
|Disconnect the |   |'free' connec- |    |at pin B |
|electrical con-|   |tor 1X282-A,   |    |of the   |
|nector from the|   |2X282-A,       |    |'free'   |
|affected       |   |3X282-A or     |    |connector|
|KW/KVAR meter  |   |4X282-A and    |    |1X282-A, |
|e.g., connector|   |terminal A2 of |    |2X282-A, |
|1X282-A from   |   |the associated |    |3X282-A  |
|No.1 Meter     |   |Circuit Breaker|    |or       |
|(212); connec- |   |(165),(166),   |    |4X282-A. |
|tor 2X282-A    |   |(167) or (168).|     ---------
|from No.2 Meter|    ---------------          |
|(213); connec- |          |                  |
|tor 3X282-A    |          NO                 NO
|from No.3 Meter|          |                  |
|(214); connec- |    --------------------------------
|tor 4X282-A    |   |Renew the associated C/O relay,|
|from No.4 Meter|   |i.e., *renew Nos.1 & 2 KW/KVAR |
|(215).         |   |meters C/O relay (224) or      |
 ---------------    |*renew Nos.3 & 4 KW/KVAR meters|
                    |C/O Relay (225). Refit the     |
                    |connector to the associated    |
                    |KW/KVAR Meter (212),(213),     |
                    |(214) or (215).                |
                     --------------------------------
```

Chart 130 (Sheet 1 of 2)

Continued from Sheet 1

Check continuity of the associated current transformer winding between pin F and pin A of the KW/KVAR meter 'free' connector 1X282-A, 2X282-A, 3X282-A or 4X282-A.

- YES → Renew KW/KVAR Meter (212),(213),(214) or (215),together with the associated (matched) Resistor (216), (217), (218) or (219).
- NO → *Renew Current Transformer (220), (221),(222), or (223). Refit the connector to the associated KW/KVAR Meter (212), (213), (214) or (215).

Chart 130 (Sheet 2 of 2)

*WITH THE ASSOCIATED GENERATOR ON-LINE, A KW/KVAR METER GIVES ZERO 'KW' INDICATION I.E., WHEN 'PUSH FOR KVAR' SWITCH IS OPERATED.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Shut down the running engines (Ref. Chap.71).

*Renew associated C/O relay, i.e., Nos.1 & 2 KW/KVAR Meters C/O Relay (224) or Nos.3 & 4 KW/KVAR Meters C/O Relay (225). Is fault cleared?

NO

*Renew associated KW/KVAR Meter (212),(213),(214) or (215), together with the (matched) Resistor (216),(217),(218) or (219). Is fault cleared?

NO

Renew CB (165), (166), (167) or (168).

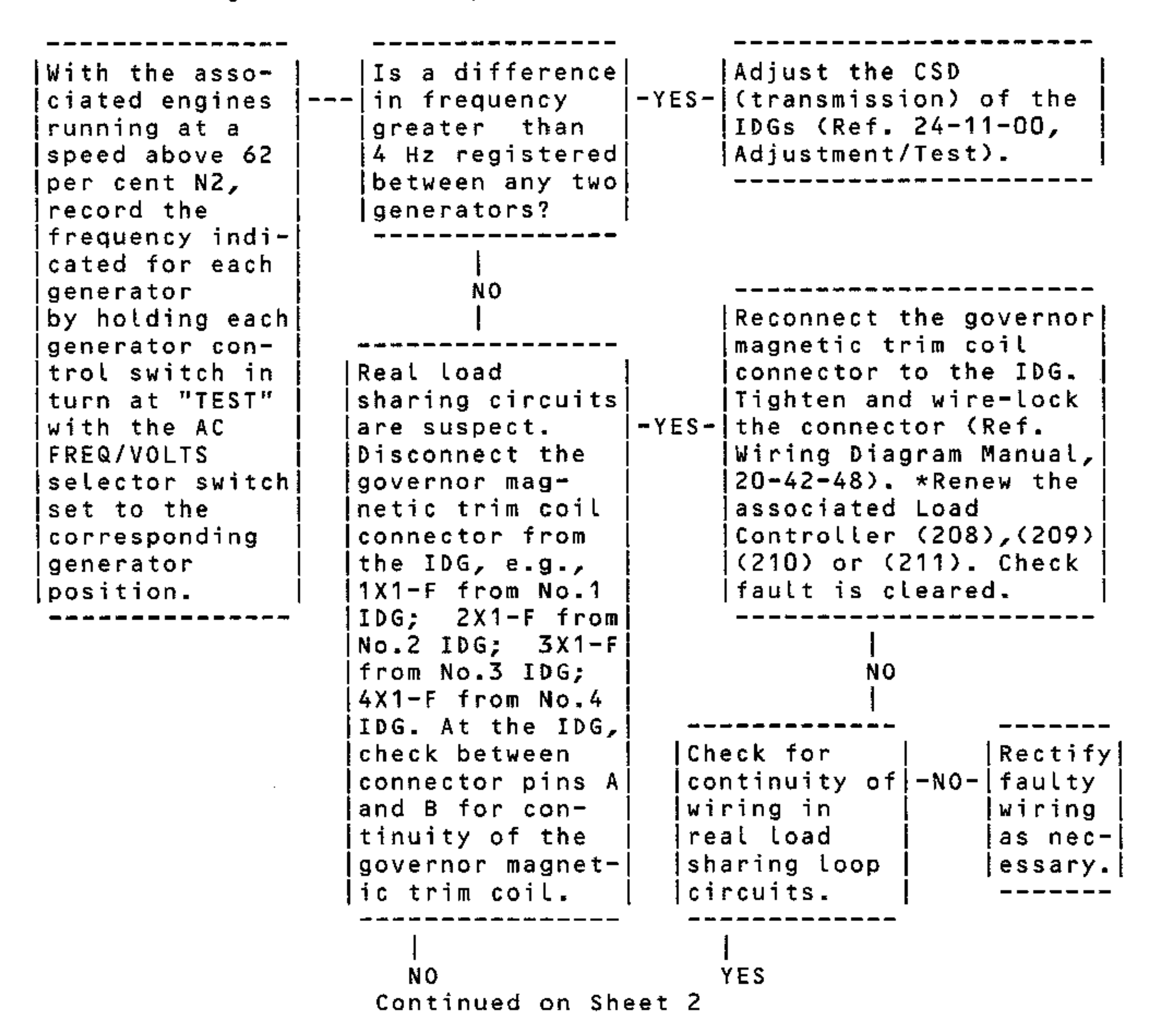
Chart 131

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```
*******************************
*WITH TWO OR MORE GENERATORS  *
*ON-LINE. A 'KW/KVAR' METER   *
*INDICATES A LOAD SHARING     *
*DIFFERENCE EXCEEDING 6 kW.   *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.



Continued on Sheet 2

Chart 132 (Sheet 1 of 2)

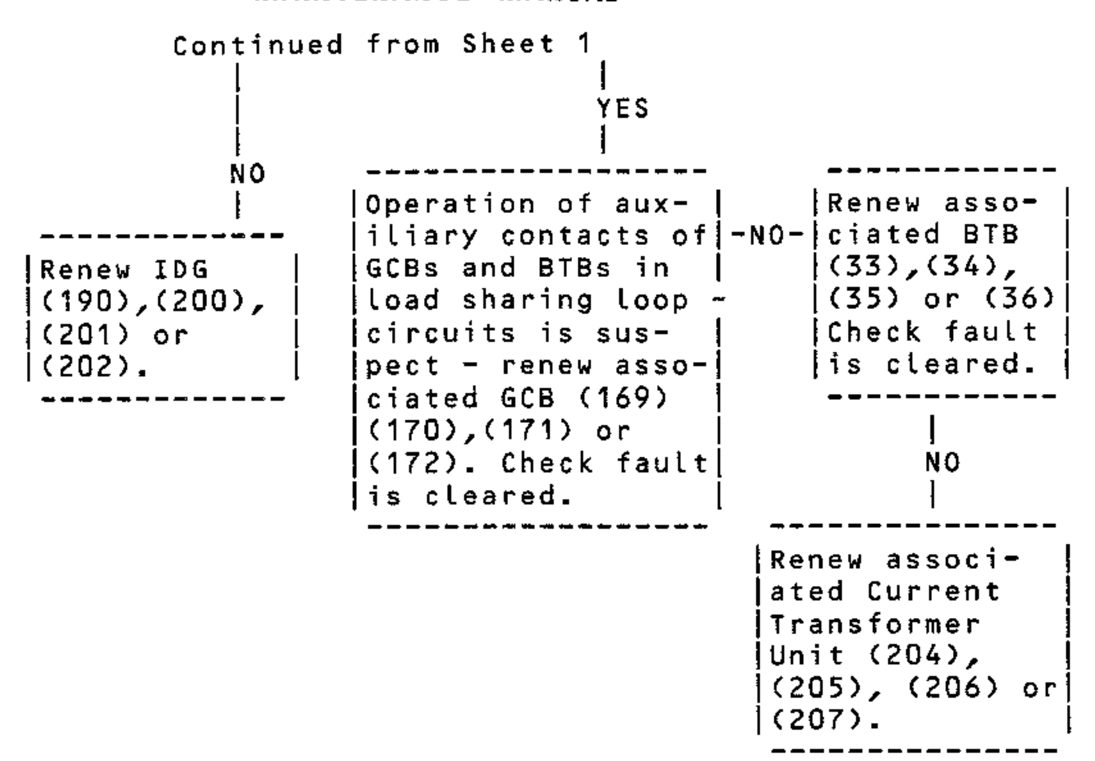


Chart 132 (Sheet 2 of 2)

****
*WITH TWO OR MORE GENERATORS *
*ON-LINE, A 'KW/KVAR' METER *
*INDICATES A LOAD SHARING *
*DIFFERENCE EXCEEDING 4 kVAR. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Reactive load sharing circuits are suspect. Shut down the running engines (Ref. Chap.71). *Renew associated CPU (128),(129), (130), or (131). Check fault is cleared.

-NO-

Check for continuity of wiring in reactive load sharing loop circuits.

-YES-

Operation of auxiliary contacts of GCBs and BTBs in load sharing loop circuits is suspect - renew associated GCB (169),(170),(171) or (172). Check fault is cleared.

NO (from check for continuity):

Rectify faulty wiring as necessary.

NO (from operation of auxiliary contacts):

Renew associated BTB (33), (34), (35) or (36). Check fault is cleared.

NO

Renew associated Current Transformer Unit (204),(205),(206) or (207).

Chart 133

****
*WITH THE ASSOCIATED ENGINE *
*RUNNING AT A SPEED ABOVE 62 *
*PER CENT N2, THE TEMPERATURE *
*INDICATED ON THE 'INLET' OR *
*'DIFF' SCALE OF A CSD OIL *
*TEMPERATURE INDICATOR IS *
*ABNORMALLY HIGH OR ABNORMALLY *
*LOW OR THE OVERHEAT WARNING *
*LAMP ON THE INDICATOR IS LIT. *
CSD OIL TEMPERATURE INDICATION
*CIRCUITS CHECKED AND FOUND *
*CORRECT. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
As required by cross-reference	-

Check the record of the fault indication. ---- Does record show inlet temperature high with or without overheat warning lamp lit - differential temperature normal?

- NO → Does record show inlet temperature normal - differential temperature high?
  - YES → Renew IDG (199), (200), (201) or (202).
- YES → Check that the operation of the oil cooling system is correct (Ref. Chap.79)
  - NO → Locate and rectify fault in the oil cooling system (Ref. Chap.79).
  - YES → Check that the IDG oil level is correct (Ref. 24-11-11, Inspection/ Check).
    - YES → Continued on Sheet 2

Chart 134 (Sheet 1 of 2)

Continued from Sheet 1

YES

Inspect the IDG magnetic drain plug for evidence of contamination and the differential pressure indicators on the charge oil and scavenge filters for indication of filter blockage and take action as required (Ref. 24-11-11, Inspection/Check). Check that further running of the IDG is permitted by the Inspection/Check requirements.

-YES-

Check that the IDG is correctly filled and primed with oil (Ref. 24-11-11, Servicing). Check that the transmission is engaged, by pulling the disconnect/reset handle at the bottom of the IDG. Start and run the associated engine at a speed above 62 per cent N2, (Ref. Preparation, para.2.M., and 71-00-00). Check that fault has cleared.

NO (from inspection box):

Renew IDG (199), (200), (201) or (202).

NO (from check box):

Renew IDG (199), (200), (201)or (202).

Chart 134 (Sheet 2 of 2).

WITH EMERGENCY GENERATOR MODE SWITCH AT 'GRND BY-PASS' AND NO.2 ENGINE RUNNING ABOVE 62 PER CENT N2, EMERGENCY GENERATOR 'SELECTED' CAPTION IS ILLUMINATED WHEN NO.1 ENGINE IS SHUT DOWN.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Shut down No.2 engine (Ref. 71-00-00). Ensure that operation of the ASB has been checked and cleared in accordance with the procedures detailed in paragraph 4., Emergency Generation - Preliminary.

→ Check the Engine Pulse Probe Unit (164) in accordance with the applicable test procedures (Ref. 71-50-00, Adjustment/Test). Check that the test requirements are met.

- YES → *Renew Engine Speed Unit (95). Check that fault is cleared.
  - NO → Renew Engine Pulse Probe Unit (164).
- NO → *Renew Engine Pulse Probe Unit (164).

Chart 135

R **ON A/C 007-007,

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(1) Circuit breaker 28 V	-	1-213	1P29	Map ref.M9	24-50-00 R/I	24-31-03
(2) Circuit breaker 28 V	-	3-213	2P29	Map ref.E11	24-50-00 R/I	24-31-04
(3) BATT - FAIL/ISOL caption light module	-	6-214	1P30	3CM station	24-00-00 R/I	24-31-03
(4) BATT - FAIL/ISOL caption light module	-	6-214	2P30	3CM station	24-00-00 R/I	24-31-04
(5) Battery isolate contactor	-	12-215	1P20	Flight compartment LH racking	24-00-00 R/I	24-31-03
(6) Battery isolate contactor	-	12-216	2P20	Flight compartment RH racking	24-00-00 R/I	24-31-04
(7) Battery isolate magnetic indicator	-	6-214	1P31	3CM station	24-00-00 R/I	24-31-03
(8) Battery isolate magnetic indicator	-	6-214	2P31	3CM station	24-00-00 R/I	24-31-04
(9) Battery control switch	-	6-214	1P25	3CM station	24-00-00 R/I	24-31-03
(10) Battery control switch	-	6-214	2P25	3CM station	24-00-00 R/I	24-31-04
(11) BATT.A CONTROL circuit	-	16-215	1P24	Flight compartment LH racking	24-50-00 R/I	24-31-03

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
breaker 28 V						
(12) BATT.B CONTROL circuit breaker 28 V	-	16-216	2P24	Flight compartment RH racking	24-50-00 R/I	24-31-04
(13) No.1 split system breaker	-	24-215	X24	Flight compartment LH racking	24-00-00 R/I	24-21-07
(14) No.2 split system breaker	-	24-216	X25	Flight compartment RH racking	24-00-00 R/I	24-21-07
(15) Split system breaker control switch	-	3-214	X26	3CM station	24-00-00 R/I	24-21-07
(16) SSB position magnetic indicator	-	3-214	X27	3CM station	24-00-00 R/I	24-21-07
(17) No.1 AC MAIN BUS caption light module	-	3-214	1X16	3CM station	24-00-00 R/I	24-51-06
(18) No.2 AC MAIN BUS caption light module	-	3-214	2X16	3CM station	24-00-00 R/I	24-51-06
(19) No.3 AC MAIN BUS caption light module	-	3-214	3X16	3CM station	24-00-00 R/I	24-51-07
(20) No.4 AC MAIN BUS caption light module	-	3-214	4X16	3CM station	24-00-00 R/I	24-51-07
(21) No.1 main	-	12-215	1X15	Flight	24-51-11	24-51-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
a.c. undervolt unit				compartment LH racking	R/I	
(22) No.2 main a.c. undervolt unit	-	12-215	2X15	Flight compartment LH racking	24-51-11 R/I	24-51-06
(23) No.3 main a.c. undervolt unit	-	12-216	3X15	Flight compartment RH racking	24-51-11 R/I	24=51=07
(24) No.4 main a.c. undervolt unit	-	12-216	4X15	Flight compartment RH racking	24-51-11 R/I	24-51-07
(25) Circuit breaker 28 V	-	1-213	1X125	Map ref.Q7	24-50-00 R/I	24-51-06
(26) Circuit breaker 28 V	-	1-213	2X125	Map ref.Q8	24-50-00 R/I	24-51-06
(27) Circuit breaker 28 V	-	3-213	3X125	Map ref.F8	24-50-00 R/I	24-51-07
(28) Circuit breaker 28 V	-	3-213	4X125	Map ref.F9	24-50-00 R/I	24-51-07
(29) No.1 BTB position magnetic indicator	-	3-214	1X10	3CM station	24-00-00 R/I	24-21-06
(30) No.2 BTB position magnetic indicator	-	3-214	2X10	3CM station	24-00-00 R/I	24-21-06
(31) No.3 BTB position magnetic indicator	-	3-214	3X10	3CM station	24-00-00 R/I	24-21-06
(32) No.4 BTB position magnetic	-	3-214	4X10	3CM station	24-00-00 R/I	24-21-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
indicator						
(33) No.1 bus-tie breaker (BTB)	-	24-215	1X6	Flight compartment LH racking	24-00-00 R/I	24-21-06
(34) No.2 bus-tie breaker (BTB)	-	24-215	2X6	Flight compartment LH racking	24-00-00 R/I	24-21-06
(35) No.3 bus-tie breaker (BTB)	-	24-216	3X6	Flight compartment RH racking	24-00-00 R/I	24-21-06
(36) No.4 bus-tie breaker (BTB)	-	24-216	4X6	Flight compartment RH racking	24-00-00 R/I	24-21-06
(37) No.1 BTB control switch	-	3-214	1X9	3CM station	24-00-00 R/I	24-21-06
(38) No.2 BTB control switch	-	3-214	2X9	3CM station	24-00-00 R/I	24-21-06
(39) No.3 BTB control switch	-	3-214	3X9	3CM station	24-00-00 R/I	24-21-06
(40) No.4 BTB control switch	-	3-214	4X9	3CM station	24-00-00 R/I	24-21-06
(41) No.1 a.c. essential undervoltage unit	-	12-215	1X127	Flight compartment LH racking	24-51-11 R/I	24-51-06
(42) No.2 a.c. essential undervoltage unit	-	12-215	2X127	Flight compartment LH racking	24-51-11 R/I	24-51-06
(43) No.3 a.c. essential undervoltage unit	-	12-216	3X127	Flight compartment RH racking	24-51-11 R/I	24-51-07

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(44) No.4 a.c. essential undervoltage unit	-	12-216	4X127	Flight compartment RH racking	24-51-11 R/I	24-51-07
(45) No.1 AC ESS BUS caption light module	-	6-214	1X129	3CM station	24-00-00 R/I	24-51-06
(46) No.2 AC ESS BUS caption light module	-	6-214	2X129	3CM station	24-00-00 R/I	24-51-06
(47) No.3 AC ESS BUS caption light module	-	6-214	3X129	3CM station	24-00-00 R/I	24-51-07
(48) No.4 AC ESS BUS caption light module	-	6-214	4X129	3CM station	24-00-00 R/I	24-51-07
(49) Emergency generator KVA meter	-	6-214	X205	3CM station	24-00-00 R/I	24-22-02
(50) No.1 essential/main control switch	-	6-214	1X128	3CM station	24-00-00 R/I	24-51-06
(51) No.2 essential/main control switch	-	6-214	2X128	3CM station	24-00-00 R/I	24-51-06
(52) No.3 essential/main control switch	-	6-214	3X128	3CM station	24-00-00 R/I	24-51-07
(53) No.4 essential/main control switch	-	6-214	4X128	3CM station	24-00-00 R/I	24-51-07
(54) No.1 essential/main change-over contactor	-	12-215	1X126	Flight compartment LH racking	24-00-00 R/I	24-51-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(55) No.2 essential/main change-over contactor	-	12-215	2X126	Flight compartment LH racking	24-00-00 R/I	24-51-06
(56) No.3 essential/main change-over contactor	-	12-216	3X126	Flight compartment RH racking	24-00-00 R/I	24-51-07
(57) No.4 essential/main change-over contactor	-	12-216	4X126	Flight compartment RH racking	24-00-00 R/I	24-51-07
(58) No.1 essential/main isolate magnetic indicator	-	6-214	1X130	3CM station	24-00-00 R/I	24-51-06
(59) No.2 essential/main isolate magnetic indicator	-	6-214	2X130	3CM station	24-00-00 R/I	24-51-06
(60) No.3 essential/main isolate magnetic indicator	-	6-214	3X130	3CM station	24-00-00 R/I	24-51-07
(61) No.4 essential/main isolate magnetic indicator	-	6-214	4X130	3CM station	24-51-00 R/I	24-51-07
(62) Circuit breaker 28 V	-	1-213	1X123	Map ref.Q9	24-50-00 R/I	24-51-06
(63) Circuit breaker 28 V	-	3-213	4X123	Map ref.F10	24-50-00 R/I	24-51-07

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(64) No.1 TRU ammeter	-	6-214	1P6	3CM station	24-00-00 R/I	24-31-52
(65) No.2 TRU ammeter	-	6-214	2P6	3CM station	24-00-00 R/I	24-31-52
(66) No.3 TRU ammeter	-	6-214	3P6	3CM station	24-00-00 R/I	24-31-52
(67) No.4 TRU ammeter	-	6-214	4P6	3CM station	24-00-00 R/I	24-31-52
(68) No.1 TRU control switch	-	6-214	1P3	3CM station	24-00-00 R/I	24-31-01
(69) No.2 TRU control switch	-	6-214	2P3	3CM station	24-00-00 R/I	24-31-01
(70) No.3 TRU control switch	-	6-214	3P3	3CM station	24-00-00 R/I	24-31-02
(71) No.4 TRU control switch	-	6-214	4P3	3CM station	24-00-00 R/I	24-31-02
(72) No.1 TRU isolate contactor	-	12-215	1P2	Flight compartment LH racking	24-00-00 R/I	24-31-01
(73) No.2 TRU isolate contactor	-	12-215	2P2	Flight compartment LH racking	24-00-00 R/I	24-31-01
(74) No.3 TRU isolate contactor	-	12-216	3P2	Flight compartment RH racking	24-00-00 R/I	24-31-02
(75) No.4 TRU isolate contactor	-	12-216	4P2	Flight compartment RH racking	24-00-00 R/I	24-31-02
(76) DC MAIN BUS caption light module	-	6-214	P17	3CM station	24-00-00 R/I	24-52-04

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(77) Circuit breaker 28 V	-	1-213	P16	Map ref.N9	24-50-00 R/I	24-52-04
(78) 'A' system essential/main split magnetic indicator	-	6-214	1P14	3CM station	24-00-00 R/I	24-52-04
(79) 'B' system essential/main split magnetic indicator	-	6-214	2P14	3CM station	24-00-00 R/I	24-52-04
(80) 'A' system DC ESS BUS caption light module	-	6-214	1P28	3CM station	24-00-00 R/I	24-52-04
(81) 'A' system essential undervolt relay	-	12-215	1P27	Flight compartment LH racking	24-00-00 R/I	24-52-04
(82) 'B' system DC ESS BUS caption light module	-	6-214	2P28	3CM station	24-00-00 R/I	24-52-04
(83) 'B' system essential undervolt relay	-	12-216	2P27	Flight compartment RH racking	24-00-00 R/I	24-52-04
(84) Circuit breaker 28 V	-	1-213	1P29	Map ref.M9	24-50-00 R/I	24-52-04
(85) Circuit breaker 28 V	-	3-213	2P29	Map ref.E11	24-50-00 R/I	24-52-04
(86) SELECTED caption light module	-	6-214	X221	3CM station	24-00-00 R/I	24-22-02
(87) FAIL caption light module	-	6-214	X222	3CM station	24-00-00 R/I	24-22-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(88) Emergency generator control and protection unit	-	5-243	X201	Rear racking	24-22-21 R/I	24-22-02
(89) EMERG. POWER circuit breaker 28 V	-	23-215	X210	Flight compartment LH racking	24-50-00 R/I	24-22-02
(90) Circuit breaker 28 V	-	1-213	X211	Map ref.R9	24-50-00 R/I	24-22-01
(91) Emergency generator isolate control switch	-	6-214	X219	3CM station	24-00-00 R/I	24-22-01
(92) Emergency generator mode switch	-	6-214	X218	3CM station	24-00-00 R/I	24-22-01
(93) Circuit breaker 28 V	-	3-213	X212	Map ref.G10	24-50-00 R/I	24-22-01
(94) Diode	-	12-215	X213	Flight compartment LH racking	24-00-00 R/I	24-22-01
(95) Engine speed unit	-	1-215	X223	Flight compartment LH racking	24-22-22 R/I	24-22-01
(96) Latching relay	-	12-215	X217	Flight compartment LH racking	24-00-00 R/I	24-22-01
(97) LH weight switch operated relay	-	2-123	G308	Forward underfloor racking	32-00-00 R/I	32-61-06
(98) RH weight switch operated relay	-	3-123	G311	Forward underfloor racking	32-00-00 R/I	32-61-06
(99) Latching	-	12-215	X231	Flight	24-00-00	24-22-01

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
relay time delay				compartment LH racking	R/I	
(100) Auto shed breaker (ASB)	-	12-215	X224	Flight compartment LH racking	24-00-00 R/I	24-51-06
(101) ASB position magnetic indicator	-	6-214	X225	3CM station	24-00-00 R/I	24-51-06
(102) Temper- ature con- trolled relay	-	7-243	X207	Rear racking	24-22-00 R/I	24-22-02
(103) Emergency generator O/HEAT caption light module	-	6-214	X209	3CM station	24-00-00 R/I	24-22-02
(104) Temper- ature con- trolled relay	-	7-243	X208	Rear racking	24-22-00 R/I	24-22-02
(105) Circuit breaker 115 V	-	2-213	1X131	Map ref.D18	24-50-00 R/I	24-23-11
(106) Circuit breaker 115 V	-	4-213	2X131	Map ref.B13	24-50-00 R/I	24-23-11
(107) 'A' system load shed contactor	-	12-215	1X133	Flight compartment LH racking	24-00-00 R/I	24-51-06
(108) 'B' system load shed contactor	-	12-216	2X133	Flight compartment RH racking	24-00-00 R/I	24-51-07
(109) 26 V a.c. transformer	-	12-215	1X132	Flight compartment LH racking	24-23-11 R/I	24-23-11
(110) 26 V a.c. transformer	-	12-216	2X132	Flight compartment	24-23-11 R/I	24-23-11

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
				RH racking		
(111) 'A' avionics load shed contactor	-	12-215	1X521	Flight compartment LH racking	24-00-00 R/I	24-51-06
(112) 'B' avionics load shed contactor	-	12-216	2X521	Flight compartment RH racking	24-00-00 R/I	24-51-07
(113) AVIONIC LOAD SHED 'A' SYS SUP circuit breaker 115 V	-	21-215	1X520	Flight compartment LH racking	24-50-00 R/I	24-51-31
(114) AVIONIC LOAD SHED 'B' SYS SUP circuit breaker 115 V	-	21-216	2X520	Flight compartment RH racking	24-50-00 R/I	24-51-31
(115) Circuit breaker 115 V	-	2-213	X137	Map ref.B22	24-50-00 R/I	24-24-01
(116) Static inverter control relay	-	19-215	X139	Flight compartment LH racking	24-24-00 R/I	24-24-01
(117) Ram air turbine (RAT) control switch	-	14-214	M763	3CM station	29-00-00 R/I	29-24-01
(118) Ram air turbine (RAT) control switch	-	14-214	M764	3CM station	29-00-00 R/I	29-24-01
(119) 26 V a.c. transformer	-	18-215	X135	Flight compartment LH racking	24-24-11 R/I	24-24-01
(120) Circuit breaker 115 V	-	1-213	X138	Map ref.N10	24-50-00 R/I	24-24-01
(121) Static	-	9-215	X140	Flight	24-24-12	24-24-01

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
inverter				compartment LH racking	R/I	
(122) 'A' system essential/main split contactor	-	12-215	1P9	Flight compartment LH racking	24-00-00 R/I	24-52-04
(123) 'B' system essential/main split contactor	-	12-216	2P9	Flight compartment RH racking	24-00-00 R/I	24-52-04
(124) 'A' system main d.c. undervolt unit	-	12-215	1P15	Flight compartment LH racking	24-52-11 R/I	24-52-04
(125) 'B' system main d.c. undervolt unit	-	12-216	2P15	Flight compartment RH racking	24-52-11 R/I	24-52-04
(126) Fuse	-	12-215	1P11	Flight compartment LH racking	24-00-00 R/I	24-31-01
(127) Fuse	-	12-216	2P11	Flight compartment RH racking	24-00-00 R/I	24-31-02
(128) No.1 control and protection unit (CPU)	-	2-215	1X3	Flight compartment LH racking	24-21-21 R/I	24-21-02
(129) No.2 control and protection unit (CPU)	-	1-215	2X3	Flight compartment LH racking	24-21-21 R/I	24-21-02
(130) No.3 control and protection unit (CPU)	-	1-216	3X3	Flight compartment RH racking	24-21-21 R/I	24-21-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(131) No.4 control and protection unit (CPU)	-	2-216	4X3	Flight compartment RH racking	24-21-21 R/I	24-21-02
(132) No.1 essential neon indicator lamp	-	2-213	1X136	Inside face of CB panel 2-213	24-50-00 R/I	24-51-06
(133) No.2 essential neon indicator lamp	-	2-213	2X136	Inside face of CB panel 2-213	24-50-00 R/I	24-51-06
(134) No.3 essential neon indicator lamp	-	4-213	3X136	Inside face of CB panel 4-213	24-50-00 R/I	24-51-07
(135) No.4 essential neon indicator lamp	-	4-213	4X136	Inside face of CB panel 4-213	24-50-00 R/I	24-51-07
(136) Circuit breaker 115/200 V	-	2-213	1X124	Map ref.C23	24-50-00 R/I	24-51-06
(137) Circuit breaker 115/200 V	-	2-213	2X124	Map ref.D23	24-50-00 R/I	24-51-06
(138) Circuit breaker 115/200 V	-	4-213	3X124	Map ref.A14	24-50-00 R/I	24-51-07
(139) Circuit breaker 115/200 V	-	4-213	4X124	Map ref.D14	24-50-00 R/I	24-51-07
(140) No.1 RELT NORM SUP circuit breaker 115/200 V	-	22-215	1X226	Flight compartment LH racking	24-50-00 R/I	24-51-06
(141) No.2 RELT NORM SUP circuit breaker	-	21-215	2X226	Flight compartment LH racking	29-50-00 R/I	24-51-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
115/200 V						
(142) No.3 RELT NORM SUP circuit breaker 115/200 V	-	21-216	3X226	Flight compartment RH racking	24-50-00 R/I	24-51-07
(143) No.4 RELT NORM SUP circuit breaker 115/200 V	-	22-216	4X226	Flight compartment RH racking	24-50-00 R/I	24-51-07
(144) Emergency generator neon indicator lamp	-	12-215	X232	Flight compartment LH racking	24-00-00 R/I	24-22-02
(145) Circuit breaker 28 V	-	1-213	1X230	Map ref.R10	24-50-00 R/I	24-22-01
(146) Circuit breaker 28 V	-	3-213	4X230	Map ref.H8	24-50-00 R/I	24-51-07
(147) No.1 relight change-over contactor	-	12-215	1X228	Flight compartment LH racking	24-00-00 R/I	24-51-06
(148) No.2 relight change-over contactor	-	12-215	2X228	Flight compartment LH racking	24-00-00 R/I	24-51-06
(149) No.3 relight change-over contactor	-	12-215	3X228	Flight compartment LH racking	24-00-00 R/I	24-51-07
(150) No.4 relight change-over contactor	-	12-215	4X228	Flight compartment LH racking	24-00-00 R/I	24-51-07
(151) EMERG RELIGHT BUSBAR selector switch	-	18-214	X229	3CM station	24-22-00 R/I	24-51-06
(152) Emergency generator	153 DB	153	X206	Below floor of rear	24-12-12 R/I	24-22-01

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
hydraulic selector valve				baggage compartment		
(153) No.1 engine relight neon indicator lamp	-	12-215	1X233	Flight compartment LH racking	24-00-00 R/I	24-51-06
(154) No.2 engine relight neon indicator lamp	-	12-215	2X233	Flight compartment LH racking	24-00-00 R/I	24-51-06
(155) No.3 engine relight neon indicator lamp	-	12-215	3X233	Flight compartment LH racking	24-00-00 R/I	24-51-07
(156) No.4 engine relight neon indicator lamp	-	12-215	4X233	Flight compartment LH racking	24-00-00 R/I	24-51-07
(157) RELIGHT BAR Nos.1 & 4 EMERG SUPPLY circuit breaker 115/200 V	-	23-215	1X227	Flight compartment LH racking	24-50-00 R/I	24-51-07
(158) RELIGHT BAR Nos.2 & 3 EMERG SUPPLY circuit breaker 115/200 V	-	23-215	3X227	Flight compartment LH racking	24-50-00 R/I	24-51-07
(159) VOLTS/ FREQ IND circuit breaker 115 V	-	23-215	D111	Flight compartment LH racking	24-50-00 R/I	24-21-81
(160) Circuit breaker 115 V	-	2-213	X134	Map ref.C18	24-50-00 R/I	24-24-01
(161) AC FREQ/ VOLTS selector	-	6-214	D115	3CM station	24-00-00 R/I	24-21-81

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
switch						
(162) Emergency generator and drive unit	153 DB and 153 EB	153	X200	Below floor of rear baggage compartment	24-12-11 R/I	24-22-02
(163) Differential protection current transformer	-	12-215	X202	Flight compartment LH racking	24-22-12 R/I	24-22-02
(164) Engine pulse probe unit	-	400	E243	Engine accessory gearbox	76-12-02 R/I	77-11-04
(165) No.1 GEN KW/VAR METER SUP circuit breaker	-	22-215	1X280	Flight compartment LH racking	24-50-00 R/I	24-21-81
(166) No.2 GEN KW/VAR METER SUP circuit breaker	-	21-215	2X280	Flight compartment LH racking	24-50-00 R/I	24-21-81
(167) No.3 GEN KW/VAR METER SUP circuit breaker	-	21-216	3X280	Flight compartment RH racking	24-50-00 R/I	24-21-81
(168) No.4 GEN KW/VAR METER SUP circuit breaker	-	22-216	4X280	Flight compartment RH racking	24-50-00 R/I	24-21-81
(169) No.1 GCB position magnetic indicator	-	3-214	1X8	3CM station	24-00-00 R/I	24-21-02
(170) No.2 GCB position magnetic indicator	-	3-214	2X8	3CM station	24-00-00 R/I	24-21-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(171) No.3 GCB position magnetic indicator	-	3-214	3X8	3CM station	24-00-00 R/I	24-21-02
(172) No.4 GCB position magnetic indicator	-	3-214	4X8	3CM station	24-00-00 R/I	24-21-02
(173) GEN 1 caption light module	-	3-214	1X13	3CM station	24-00-00 R/I	24-21-02
(174) GEN 2 caption light module	-	3-214	2X13	3CM station	24-00-00 R/I	24-21-02
(175) GEN 3 caption light module	-	3-214	3X13	3CM station	24-00-00 R/I	24-21-02
(176) GEN 4 caption light module	-	3-214	4X13	3CM station	24-00-00 R/I	24-21-02
(177) No.1 generator circuit breaker (GCB)	-	24-215	1X5	Flight compartment LH racking	24-00-00 R/I	24-21-02
(178) No.2 generator circuit breaker (GCB)	-	24-215	2X5	Flight compartment LH racking	24-00-00 R/I	24-21-02
(179) No.3 generator circuit breaker (GCB)	-	24-216	3X5	Flight compartment RH racking	24-00-00 R/I	24-21-02
(180) No.4 generator circuit breaker (GCB)	-	24-216	4X5	Flight compartment RH racking	24-00-00 R/I	24-21-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(181) Circuit breaker 28 V	-	1-213	1X12	Map ref.P9	24-50-00 R/I	24-21-02
(182) Circuit breaker 28 V	-	3-213	4X12	Map ref.E10	24-50-00 R/I	24-21-02
(183) No.1 generator control switch	-	3-214	1X7	3CM station	24-00-00 R/I	24-21-02
(184) No.2 generator control switch	-	3-214	2X7	3CM station	24-00-00 R/I	24-21-02
(185) No.3 generator control switch	-	3-214	3X7	3CM station	24-00-00 R/I	24-21-02
(186) No.4 generator control switch	-	3-214	4X7	3CM station	24-00-00 R/I	24-21-02
(187) Circuit breaker 28 V	-	1-213	1X310	Map ref.R7	24-50-00 R/I	24-11-01
(188) Circuit breaker 28 V	-	1-213	2X310	Map ref.R8	24-50-00 R/I	24-11-02
(189) Circuit breaker 28 V	-	3-213	3X310	Map ref.G8	24-50-00 R/I	24-11-03
(190) Circuit breaker 28 V	-	3-213	4X310	Map ref.G9	24-50-00 R/I	24-11-04
(191) No.1 IDG oil low pressure warning switch	-	415	-	Part of integrated drive generator	24-11-11 R/I	24-11-01
(192) No.2 IDG oil low pressure warning switch	-	426	-	Part of integrated drive generator	24-11-11 R/I	24-11-02
(193) No.3 IDG	-	435	-	Part of	24-11-11	24-11-03

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
oil low pressure warning switch				integrated drive generator	R/I	
(194) No.4 IDG oil low pressure warning switch	-	446	-	Part of integrated drive generator	24-11-11 R/I	24-11-04
(195) CSD 1 caption light module	-	3-214	1X312	3CM station	24-00-00 R/I	24-11-01
(196) CSD 2 caption light module	-	3-214	2X312	3CM station	24-00-00 R/I	24-11-02
(197) CSD 3 caption light module	-	3-214	3X312	3CM station	24-00-00 R/I	24-11-03
(198) CSD 4 caption light module	-	3-214	4X312	3CM station	24-00-00 R/I	24-11-04
(199) No.1 integrated drive generator (IDG)	-	415	1X1	No.1 engine RH access-ory gearbox	24-11-11	24-21-02
(200) No.2 integrated drive generator (IDG)	-	426	2X1	No.2 engine RH access-ory gearbox	24-11-11 R/I	24-21-02
(201) No.3 integrated drive generator (IDG)	-	435	3X1	No.3 engine RH access-ory gearbox	24-11-11 R/I	24-21-02
(202) No.4 integrated drive generator (IDG)	-	446	4X1	No.4 engine RH access-ory gearbox	24-11-11 R/I	24-21-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(203) Ground power breaker (GPB)	-	24-216	X21	Flight compartment RH racking	24-00-00 R/I	24-41-01
(204) No.1 differential protection current transformer unit	-	24-215	1X2	Flight compartment LH racking	24-21-12 R/I	24-21-02
(205) No.2 differential protection current transformer unit	-	24-215	2X2	Flight compartment LH racking	24-21-12 R/I	24-21-02
(206) No.3 differential protection current transformer unit	-	24-216	3X2	Flight compartment RH racking	24-21-12 R/I	24-21-02
(207) No.4 differential protection current transformer unit	-	24-216	4X2	Flight compartment RH racking	24-21-12 R/I	24-21-02
(208) No.1 load controller	-	2-215	1X314	Flight compartment LH racking	24-11-21 R/I	24-11-01
(209) No.2 load controller	-	1-215	2X314	Flight compartment LH racking	24-11-21 R/I	24-11-02
(210) No.3 load controller	-	1-216	3X314	Flight compartment RH racking	24-11-21 R/I	24-11-03
(211) No.4 load	-	2-216	4X314	Flight	24-11-21	24-11-04

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
controller				compartment RH racking	R/I	
(212) No.1 KW/ KVAR meter	-	3-214	1X282	3CM station	24-00-00 R/I	24-21-91
(213) No.2 KW/ KVAR meter	-	3-214	2X282	3CM station	24-00-00 R/I	24-21-91
(214) No.3 KW/ KVAR meter	-	3-214	3X282	3CM station	24-00-00 R/I	24-21-91
(215) No.4 KW/ KVAR meter	-	3-214	4X282	3CM station	24-00-00 R/I	24-21-91
(216) No.1 KW/ KVAR meter resistor	-	12-215	1X283	Flight compartment LH racking	24-00-00 R/I	24-21-91
(217) No.2 KW/ KVAR meter resistor	-	12-215	2X283	Flight compartment LH racking	24-00-00 R/I	24-21-91
(218) No.3 KW/ KVAR meter resistor	-	12-216	3X283	Flight compartment RH racking	24-00-00 R/I	24-21-91
(219) No.4 KW/ KVAR meter resistor	-	12-216	4X283	Flight compartment RH racking	24-00-00 R/I	24-21-91
(220) No.1 KW/ KVAR meter current transformer	-	24-215	1X284	Flight compartment LH racking	24-00-00 R/I	24-21-91
(221) No.2 KW/ KVAR meter current transformer	-	24-215	2X284	Flight compartment LH racking	24-00-00 R/I	24-21-91
(222) No.3 KW/ KVAR meter current transformer	-	24-216	3X284	Flight compartment RH racking	24-00-00 R/I	24-21-91

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(223) No.4 KW/ KVAR meter current transformer	-	24-216	4X284	Flight compartment RH racking	24-00-00 R/I	24-21-91
(224) Nos.1 & 2 KW/KVAR meters c/o relay	-	12-215	1X285	Flight compartment LH racking	24-00-00 R/I	24-21-91
(225) Nos.3 & 4 KW/KVAR meters c/o relay	-	12-216	4X285	Flight compartment RH racking	24-00-00 R/I	24-21-91
(226) PUSH FOR KVAR switch	-	3-214	X286	3CM station	24-00-00 R/I	24-21-91
(227) Emergency generator KVA meter current transformer	-	12-215	X203	Flight compartment RH racking	24-00-00 R/I	24-22-02
(228) Circuit breaker 28 V	-	15-215	X281	Flight compartment LH racking	24-50-00 R/I	24-21-91
(229) Circuit breaker 28 V	-	15-215	1P13	Flight compartment LH racking	24-50-00 R/I	24-52-04
(230) Circuit breaker 28 V	-	15-216	2P13	Flight compartment LH racking	24-50-00 R/I	24-52-04
(231) Diode	-	6-214	X234	3CM station	24-00-00 R/I	24-22-02
(232) DC NORM/SPLIT control switch	-	6-214	P34	3CM station	24-00-00 R/I	24-52-04
(233) BATT A CHARGE CONT SUP circuit breaker 28 V	-	1-213	1P33	Map ref. P.10	24-00-00 R/I	24-31-03

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(234) BATT B CHARGE CONT SUP circuit breaker 28 V	-	3-213	2P33	Map ref. H.11	24-00-00 R/I	24-31-04
(235)'A' battery charge controller	123-AB	29-123	1P35	Forward underfloor racking	24-31-13 R/I	24-31-03
(236) 'B' battery charge controller	123-AB	29-123	2P35	Forward underfloor racking	24-31-13 R/I	24-31-04
(237) Override relay	-	12-215	X235	Flight compartment LH racking	24-00-00 R/I	24-22-01

Component Identification
Table 103

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R **ON A/C 001-006,

GENERAL - TROUBLE SHOOTING

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN SERVICING AND THE HYDRAULIC SAFETY PRECAUTIONS DETAILED IN 29-00-00.

1. General

Faults are dealt with on a probability basis and identified as a result of testing.

The defect can be isolated with the aid of trouble shooting procedures (Ref. paras.3. to 13. inclusive), and traced through IF OK and IF NOT OK paths to the appropriate charts or other specified rectification action as may be necessary. If a defect occurs, perform the appropriate rectification action, then repeat the operation at which the defect was encountered to ensure that the operation is OK.

Bracketed numbers in the preparation procedures and charts indicate items on the component identification table (Ref. Table 103). The table provides information, including component location, required for rectification. Component location also indicates the possible necessity of repositioning certain items of ground service equipment. Each chart also specifies the ground equipment required for that particular task.

All procedures dealing with trouble shooting are based on the assumption that electrical wiring is serviceable, all associated circuit breakers are set and electrical power is available, unless otherwise stated. If the fault is not rectified, check the wiring in accordance with the Wiring Diagram Manual (Ref. Table 103).

This topic contains trouble shooting in sections directly related to the Operational and Functional Tests (Ref. 24-00-00, Adjustment/Test) of the Electrical Power System. The first section is designated 'Preliminary' for trouble shooting procedures applied to the Operational Test; the subsequent sections follow the sequence of the individual Functional Test procedures.

The circuits for Nos.1, 2, 3 and 4 generation channels are similar. Therefore, where equipment identical in each channel is involved, trouble shooting for No.1 channel is given by the first component identification reference (Table 103) and for Nos.2, 3 and 4 channels in that order, by the subsequent component references. E.g., on Chart 102 - Check

for 28 V d.c. at terminal 2 of AC MAIN BUS Caption Light Module (17), (18), (19), or (20) - (17) - channel 1, (18) - channel 2, etc.

2. Preparation

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

NOTE: The required preparation instructions are selected as detailed in the relevant section of the trouble shooting procedures, paragraph 3. et seq.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Throttle control system test set, required for Emergency Generation Preliminary procedures (Ref. para.C.)	QTA16-24
Decade resistance boxes, range 100 - 200 ohm (two), required for Emergency Generator Overheat Indication procedures (Ref. para.D.)	-
Test lamps, 28 V (four), required for 26 V 400 Hz AC Generation procedures (Ref. para.E.)	-
Neon test indicators, 115 V (two), required for 'A' and 'B' Avionics 115 V 400 Hz AC Busbars procedures (Ref. para.F.)	-
Test lamp, 28 V (one), required for 115/26 V AC Standby Inverter Supplies and Control procedures (Ref. para.G.)	-
Precision-grade a.c. voltmeter, range 110 - 125 V a.c., required for 115/26 V AC Standby Inverter Supplies and Control procedures	-

DESCRIPTION	PART NO.
(Ref. para.G.)	
Precision-grade frequency meter, range 350 - 450 Hz, required for 115/26 V AC Standby Inverter Supplies and Control procedures (Ref. para.G.)	-
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN), required for DC Essential/Main Split - AC Undervolt Control (Ref. para.H.)	-
Dormant circuit test test, required for Main Generation Dormant Circuits (Ref. para.I.)	TE.5002.000

B. Preliminary

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

C. Emergency Generation - Preliminary (Including Auto-shed Breaker)

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN AND THE GREEN HYDRAULIC SYSTEM MUST NOT BE PRESSURIZED DURING THESE PROCEDURES.

CAUTION: SUBSEQUENT PROCEDURES REQUIRE THE TRIPPING OF CIRCUIT BREAKERS, TO ESTABLISH LEFT-HAND AND RIGHT-HAND WEIGHT SWITCH OPERATED RELAYS IN THE 'IN-FLIGHT' POSITION. CARE MUST BE TAKEN TO ENSURE THAT ALL SERVICES ADVERSELY AFFECTED BY THIS CONDITION ARE PREVIOUSLY ISOLATED (REF. 7-11-00).

(1) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(2) Make available electrical ground power as detailed in 24-41-00.

(3) Trip the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Fit safety clips to the tripped circuit breakers.

(4) Gain access to the engine control amplifiers (throttle amplifiers) mounted on shelves 6-215 and 8-215 by removing the appropriate panels from the flight compartment left-hand racking.

(5) Locate No.1 engine main control amplifier (1K20) mounted on shelf 8-215, and No.2 engine main control amplifier (2K20) mounted on shelf 6-215.

(6) On the pilot's roof panel, 4-211, ensure that -

(a) No.1 engine and No.2 engine AUTO-IGNITION control switches are set to OFF,

(b) No.1 engine and No.2 engine HP VALVE control switches are set to SHUT, and

(c) No.1 engine and No.2 engine THROTTLE MASTER switches are set to OFF.

(7) Place a warning placard in the flight compartment forbidding alteration of the switch settings specified in paragraphs (6)(a), (b) and (c).

NOTE: The setting of Nos. 1 and 2 engine throttle levers is not significant.

(8) Connect the throttle control system test set cable 2 between connector socket PL 2 on the test set and connector socket SKT 2 on the front of No.1 engine main control amplifier (1K20).

(9) Ensure that the emergency generator isolate switch is at NORM. Set the emergency generator mode switch to "GRD BY-PASS" and ensure that the emergency generator SELECTED and FAIL captions are illuminated.

NOTE: The following test procedures do not require

the setting of any control on the test set to a particular position.

D. Emergency Generator Overheat Indication

<u>WARNING:</u> DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Trip, and fit a safety clip to, the EMER GEN AUTO CONT circuit breaker X212 (93), and the EMER GEN MANL CONT circuit breaker X211 (90).

(2) Gain access to the emergency generator by opening access door 153 DB (Ref. 52-41-41) and disconnect electrical connector X200-A from the emergency generator.

(3) Connect one decade resistance box between pins A and B of the free connector X200-A and another decade resistance box between pins G and H. Set each box at 100 ohm.

(4) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 (93).

(5) Make available electrical ground power as detailed in 24-41-00.

(6) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(7) Set the emergency generator mode switch to "GRD BY-PASS"; ensure that the emergency generator SELECTED and FAIL captions are illuminated.

E. 26 V 400 Hz AC Generation

<u>WARNING:</u> DURING THESE PROCEDURES ENSURE THAT ALL AIRCRAFT-GENERATED SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Trip the 'A' SYS 26 V AC TRANS SUP circuit breaker 1X131 (105) and the 'B' SYS 26 V AC TRANS SUP circuit breaker 2X131 (106). Fit safety clips to the tripped circuit breakers.

(4) Gain access to the 26 V a.c. 'A' and 'B' main busbars on panels 13-215 and 13-216 respectively and to the 26 V a.c. 'A' and 'B' essential busbars on panels 2-213 and 4-213 respectively, by opening these circuit breaker panels.

(5) Connect test lamps between each 26 V a.c. busbar and earth; test lamp connection points, suitable for each busbar are as follows:-

(a) 'A' main busbar: terminal 1 of circuit breaker D81 on panel 13-215, map ref.D1.

(b) 'B' main busbar: terminal 1 of circuit breaker H1010 on panel 13-216, map ref.D19.

(c) 'A' essential busbar: terminal 1 of circuit breaker 1F78 on panel 2-213, map ref.A2.

(d) 'B' essential busbar: terminal 1 of circuit breaker D211 on panel 4-213, map ref.E3.

(6) Remove the safety clips and reset the circuit breakers tripped in operation (3).

(7) Remove the warning placard and switch on ground power at source.

F. 'A' and 'B' Avionics 115 V 400 Hz AC Busbars

WARNING: DURING THESE PROCEDURES ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Trip the AVIONIC LOAD SHED 'A' SYS SUP circuit breaker 1X520 (113) and the AVIONIC LOAD SHED 'B' SYS SUP circuit breaker 2X520 (114). Fit safety

clips to the tripped circuit breakers.

(4) Gain access to the 115 V a.c. 'A' and 'B' avionics busbars on panels 13-215 and 13-216 respectively, by opening these circuit breaker panels.

(5) Connect 115 V neon test indicators, one between each 115 V avionics busbar and earth. Neon indicator connection points, suitable for each busbar, are as follows:-

(a) 'A' avionics busbar: terminal 1 of circuit breaker 1C18 on panel 13-215, map ref.A5.

(b) 'B' avionics busbar: terminal 1 of circuit breaker 2S4 on panel 13-216, map ref.G19.

(6) Remove the safety clips and reset the circuit breakers tripped in operation (3).

(7) Remove the warning placard and switch on ground power at source.

G. 115/26 V AC Standby Inverter Supplies and Control

WARNING: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Isolate the 115 V and 26 V a.c. standby busbars by tripping the 115 V A.C. STBY TRANS SUP circuit breaker X137 (115). Fit a safety clip to the tripped circuit breaker.

(4) Gain access to the 115 V and 26 V a.c. standby busbars on panel 2-213 by opening this circuit breaker panel.

(5) Connect the 110 - 125 V a.c. voltmeter and the 350 - 450 Hz frequency meter between the 115 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker X134 on panel 2-213, map ref.C18, as a suitable point for connection of the voltmeter and

frequency meter to the busbar.

(6) Connect a 28 V test lamp between the 26 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker 1F88, map ref.B1, as a suitable point for connection of the test lamp to the busbar.

(7) Remove the safety clip and reset the circuit breaker tripped in operation (3).

(8) Remove the warning placard and switch on ground power at source.

H. DC Essential/Main Split - AC Undervolt Control

WARNING: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(3) Gain access to No.3 main a.c. undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover, then disconnect and secure the cable from terminal 4 (earth) of the undervolt unit. Fit the terminal cover, then close amd secure the circuit breaker panel.

NOTE: The torque screwdriver (Ref. para.A.) is required for the subsequent reconnection of the cable to terminal 4 of the undervolt unit.

(4) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT.A and BATT.B control switches to "BATT.ON"; ensure that No.3 AC MAIN BUS AND No.3 AC ESS BUS captions are illuminated, and that both 'A' and 'B' system essential/main split magnetic indicators display in-line.

(5) Ensure that all caption filaments are serviceable

(Ref. 33-14-00).

(6) Set Nos.1,2 and 4 bus-tie breaker (BTB) control switches to "TRIP". Ensure that Nos.1, 2, 3 and 4 AC MAIN BUS and AC ESS BUS captions are illuminated, and that both 'A' and 'B' system essential/main split magnetic indicators display cross-line.

(7) Check, by observing No.3 TRU ammeter, that No.3 TRU is supplying the 'B' system main busbar.

I. Main Generation Dormant Circuits

CAUTION: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Connect electrical ground power to the ground services distribution system only (Ref. 24-41-00, Servicing, para.2.A.). If already connected, ensure that ground power is disconnected from the main a.c. distribution system by operation of the ground power control switch to the TRIP position.

(2) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(3) Gain access to Nos.1, 2, 3 and 4 control and protection units (128), (129), (130) and (131) by removing the appropriate panels from the flight compartment racking.

(4) Ensure that BATT A and BATT B control switches are set to BATT OFF.

(5) Set all four generator control switches to "OFF".

(6) Check that the SSB control switch is at CLOSE, the BTB control switches are at NORM, the GCB magnetic indicators display cross-line, the BTB magnetic indicators display in-line and the fault indicators on the front of all four control and protection units (CPUs) display 'all black' (no faults). If the test is to be applied after generation system operation has resulted in a specific fault indication on a CPU (fault indicator displays white), record the fault indication, then reset the indicator by

activating the adjacent INDICATOR RESET switch.

(7) Check that the 28 V supply switch on the dormant circuit test set is set to OFF and that all other switches on the test set are set to position 1.

(8) Using the appropriate cable loom and connector supplied therewith, connect the test set to the connector on the front of No.1 CPU.

NOTE: The 28 V d.c. external supply connector on the test set is not used for dormant circuit tests.

J. Emergency Generation - Using Hydraulic Ground Power

CAUTION: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THESE PROCEDURES.

(1) Check that all a.c. supplies are inhibited and that d.c. power is switched off.

(2) Ensure that operation of the emergency generator control circuits has been checked and cleared in accordance with the procedures detailed in paragraph 4., Emergency Generation - Preliminary.

(3) Open circuit breaker panel 1-213 to permit observation of the 'power on' neon indicator lamps that are mounted together on a panel at the end of shelF 12-215 and identified in Table 101.

NEON LAMP	'POWER ON' INDICATION
1X233	No.1 engine relight busbar
2X233	No.2 engine relight busbar
3X233	No.3 engine relight busbar
4X233	No.4 engine relight busbar
X232	Emergency generator

Neon Indicator Lamps on Panel at End of Shelf 12-215
Table 101

(4) Open circuit breaker panels 2-213 and 4-213 to permit observation of the neon indicator lamps that are mounted on the inner face of each panel and identified in Table 102.

NEON LAMP	PANEL	'POWER ON' INDICATION
1X136	2-213	No.1 a.c. essential busbar
2X136	2-213	No.2 a.c. essential busbar
3X136	4-213	No.3 a.c. essential busbar
4X136	4-213	No.4 a.c. essential busbar

Neon Indicator Lamps on Panels 2-213 and 4-213
Table 102

(5) Remove the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00) to permit access to the emergency generator control and protection unit on shelf 5-243.

(6) Make available electrical ground power as detailed in 24-41-00.

(7) Connect and supply ground hydraulic power to the 'green' hydraulic system (Ref. Chap.29).

(8) Set BATT A and BATT B control switches to "BATT ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line. Check also that the d.c. essential/main split magnetic indicators display in-line.

(9) Ensure that the EMERG RELIGHT BUSBAR selector switch on the engine starting panel (18-214) is set to OFF.

K. AC and DC Generation Master Warning

CAUTION: DURING THESE PROCEDURES, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Open the engine bay doors as required to gain access

to Nos.1, 2, 3 and 4 integrated drive generators (IDGs) (Ref. 71-00-00).

(2) Make all four CSD failure warning circuits inoperative by disconnecting the electrical connector from the oil low pressure warning switch at each IDG, i.e., connector 1X1-C (No.1 IDG), 2X1-C (No.2 IDG), 3X1-C (No.3 IDG) and 4X1-C (No.4 IDG).

(3) Isolate all four generator (GEN) failure warning indication circuits by tripping the No.1 & 2 GEN FAIL WARN IND circuit breaker 1X12 (181) and the No.3 & 4 GEN FAIL WARN IND circuit breaker 4X12 (182). Fit safety clips to the tripped circuit breakers.

(4) Make available electrical ground power as detailed in 24-41-00.

(5) Ensure that the electrical power distribution system is set for normal operation, i.e., that the setting of controls and indicators is in accordance with the requirements for the connection of electrical ground power to the main a.c. distribution system (Ref. 24-41-00, Servicing, para.2.B.).

(6) Check that all caption filaments are serviceable (Ref. 33-14-00).

(7) On the electrical generating control panel, check that the GRND PWR AVAILABLE caption and both BATT ISOLATE captions are illuminated and that all other captions are extinguished.

(8) Set both battery control switches to "BATT ON". Check that both 'battery isolate' magnetic indicators display in-line and that both BATT ISOLATE captions are extinguished.

(9) Press the RECALL button on the master warning display panel; some master warning captions may be illuminated. Press the face of each illuminated caption on the master warning display panel and check that each is extinguished (warning cancelled).

L. AC Generation - Using Main Engines

(1) Ensure that the aircraft power unit installation and systems are cleared and safe for the ground running of all four engines to be carried out (Ref. 71-00-00).

(2) Ensure that the integrated drive generator (IDG) fitted to each engine has been cleared for running (Ref. 24-11-11, Inspection/Check) and that the transmission (constant speed drive) is engaged.

(3) Make available electrical ground power as detailed in 24-41-00.

(4) Ensure that all caption filaments are serviceable (Ref. 33-14-00).

(5) Ensure that the electrical power distribution system is set for normal operation, i.e., that the setting of controls and indicators is in accordance with the requirements for the connection of electrical ground power to the main a.c. distribution system (Ref. 24-41-00, Servicing, para.2B.).

(6) Ensure that all four generator control switches are set to ON.

(7) In readiness for engine starting, set BATT A and BATT B control switches to "BATT ON", checking that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

CAUTION: IF A CSD (CONSTANT SPEED DRIVE) FAILURE CAPTION REMAINS ILLUMINATED AFTER THE ASSOCIATED ENGINE HAS RUN UP TO A SPEED OF 62 PER CENT N2 OR ABOVE, ABNORMAL OPERATION OF THE IDG IS INDICATED. THE CSD DISCONNECT SWITCH MUST THEN BE OPERATED TO THE "DISC" POSITION TO EFFECT DISENGAGEMENT OF THE IDG TRANSMISSION.

DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

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3. Trouble Shooting - Preliminary

NOTE: Before renewal of components (*), check the associated wiring for continuity.

A. *Prepare to trouble shoot (Ref. para.2.B.). Set BATT A and BATT B control switches to "BATT ON". Check that the associated battery isolate magnetic indicators change from cross-line to in-line. IF -

- OK → B.
- NOT OK → Magnetic indicator remains cross-line - Chart 101.

B. Set BATT A and BATT B control switches to "ESS/MAIN SPLIT" and check that the associated essential/main split magnetic indicators change from in-line to cross-line. Return the switch to "BATT ON" and check that the associated essential/main split magnetic indicator returns to in-line. IF -

- OK
- NOT OK →
  1. Either (A or B) essential/main split magnetic indicator remains in-line with associated battery control switch set to ESS/MAIN SPLIT - Chart 102.
  2. Either (A or B) essential/main split magnetic indicator remains cross-line with associated battery control switch set to ON - set associated battery control switch to "OFF". If magnetic indicator moves to in-line, renew Battery Control Switch (9) or (10). If magnetic indicator remains cross-line, refer to Trouble Shooting of the External Power System (Ref. 24-41-00).

C. Set the split system breaker (SSB) control switch to "OPEN" and check that both SSBs open, by observing that all four AC MAIN BUS captions are illuminated and that the SSB position magnetic indicators change from in-line to cross-line. IF -

OK → D.

NOT OK →

1. Nos.1 and 2 AC MAIN BUS captions remain extinguished - renew No.1 SSB (13).
2. Nos.3 and 4 AC MAIN BUS captions remain extinguished - renew No.2 SSB (14).
3. One AC MAIN BUS caption remains extinguished - Chart 103.
4. All four AC MAIN BUS captions remain extinguished, SSB position magnetic indicator remains in-line - renew SSB Control Switch (15).
5. All four AC MAIN BUS captions illuminated, SSBposition magnetic indicator remains in-line - renew SSV Position Magnetic Indicator (16).

D. Return the SSB control switch to "CLOSE". Set Nos.1, 2, 3 and 4 bus-tie breaker (BTB) control switches to "TRIP", in,turn and check that the associated BTB position and essential/main isolate magnetic indicators change from in-line to cross-line and the AC MAIN BUS and AC ESS BUS captions are illuminated. IF -

OK

NOT OK

1. The BTB position and essential/main isolate magnetic indicators remain in-line and the associated AC MAIN BUS and AC ESS BUS captions remain extinguished in any one channel - renew BTB Control Switch (37), (38), (39) or (40).
2. A BTB position magnetic indicator shows cross-line with the associated essential/main isolate magnetic indicator in-line and the AC MAIN BUS and AC ESS BUS captions extinguished - renew Bus-tie Breaker (33), (34) (35) or (36).
3. A BTB position magnetic indicator shows in-line with all other associated channel indications correct - renew BTB Magnetic Indicator (29), (30), (31) or (32).
4. An essential/main isolate magnetic indicator shows in-line with all other associated channel indications correct - Chart 104.
5. Either Nos.1 and 2 of Nos.3 and 4 AC ESS BUS captions remain extinguished - renew CB (62) or (63).
6. One AC ESS BUS caption remains extinguished - Chart 105.

```
E.*******************************************
  *Return Nos.1, 2, 3 and 4 BTB control     *
  *switches to "NORM", then set each trans- *
  *former rectifier (TRU) control switch to *
  *"ISOL".  Check that each TRU ammeter     *
  *indication falls to zero as the associated*
  *ISOL setting is made.  When the last TRU *
  *is isolated allow 10 s to elapse then    *
  *check that the DC MAIN BUS caption is    *
  *illuminated and both A and B essential/  *
  *main split magnetic indicators display   *
  *cross-line.  IF -                        *
  *******************************************
             |    |
             |    |                ----------------------------------
             |    |               |1. TRU ammeter indicates load, all |
             OK   NOT OK----------|   system indications correct -   |
             |                    |   renew Ammeter (64), (65), (66) |
             |                    |   or (67).                        |
             |                    |2. TRU ammeter indicates load with |
             |                    |   DC MAIN BUS caption             |
             |                    |   extinguished, 'A' and 'B'       |
             |                    |   essential/main split magnetic   |
             |                    |   indicators in-line and all TRU  |
             |                    |   isolate switches at 'ISOL' -    |
             |                    |   Chart 106.                      |
             |                    |3. DC MAIN BUS caption remains     |
             |                    |   extinguished - Chart 107.       |
             |                    |4. Essential/main split magnetic   |
             |                    |   indicator remains in-line -     |
             |                    |   Chart 108.                      |
             |                     ----------------------------------
             |
F.*******************************************
  *With the four TRUs isolated, set BATT A  *
  *control switch to "BATT OFF" and check   *
  *that 'A' system DC ESS BUS caption is    *
  *illuminated.  IF -                       *
  *******************************************
             |    |
             |    |                ----------------------------------
             |    |               |'A' system DC ESS BUS caption     |
             OK   NOT OK----------|remains extinguished - Chart 109. |
             |                     ----------------------------------
             |
```

```
           |
G.********************************************
  *With the four TRUs isolated, return BATT A*
  *control switch to "BATT ON" and set BATT B*
  *control switch to "BATT OFF" and check    *
  *that 'B' system DC ESS BUS caption is     *
  *illuminated.  IF -                        *
  ********************************************
           |    |
           |    |         ------------------------------------
           |    |        |'B' system DC ESS BUS caption       |
           OK   NOT OK------|remains extinguished - Chart 109.  |
           |              ------------------------------------
           |
H.********************************************
  *Return all four TRU control switches to   *
  *"NORM" and the BATT B control switch to   *
  *"BATT ON", and then set the emergency     *
  *generator mode switch to "MANUAL".  Check *
  *that the SELECTED and FAIL captions are   *
  *illuminated.  IF -                        *
  ********************************************
           |    |
           |    |         ------------------------------------
           |    |        |1. SELECTED caption remains         |
           OK   NOT OK------|   extinguished - renew SELECTED    |
           |             |   Caption Light Module (86).       |
           |             |2. FAIL caption remains exting-     |
           |             |   uished - Chart 110.              |
           |             |3. SELECTED and FAIL captions       |
           |             |   remain extinguished - Chart 111.|
           |              ------------------------------------
           |
I.********************************************
  *With the emergency generator mode switch  *
  *at MANUAL set the emergency generator     *
  *isolate switch to "ISOL".  Check that the *
  *SELECTED and FAIL captions are exting-    *
  *uished.  IF -                             *
  ********************************************
           |    |
           |    |         ------------------------------------
           |    |        |SELECTED and FAIL captions remain   |
           OK   NOT OK------|illuminated - renew Emergency       |
           |             |Generator Isolate Switch (91).      |
           |              ------------------------------------
           |
           |
```

```
J.*******************************************
  *Return the emergency generator isolate    *
  *switch to "NORM" and set the emergency    *
  *generator mode switch to "GRD BY-PASS".   *
  *Check that the SELECTED and FAIL captions *
  *are illuminated.  IF -                    *
  *******************************************
                |    |
                |    |           -----------------------------------
                |    |          |SELECTED and FAIL captions are     |
               OK   NOT OK------|extinguished - Chart 112.          |
                |                -----------------------------------
                |
K.*******************************************
  *Set the emergency generator isolate switch*
  *to "ISOL" and check that the SELECTED and *
  *FAIL captions are extinguished.  IF -     *
  *******************************************
                |    |
                |    |           -----------------------------------
                |    |          |SELECTED and FAIL captions remain  |
               OK   NOT OK------|illuminated - renew Emergency      |
                |               |Generator Isolate Switch (91).     |
                |                -----------------------------------
                |
L.*******************************************
  *Return the emergency generator mode switch*
  *to AUTO and the isolate switch to "NORM". *
  *Check that the SELECTED and FAIL captions *
  *are not illuminated.  IF -                *
  *******************************************
                |    |
                |    |           -----------------------------------
                |    |          |SELECTED and FAIL captions illumi- |
               OK   NOT OK------|nated - Chart 113.                 |
                |                -----------------------------------
                |
M.*******************************************
  *Set BATT A and BATT B control switches to *
  *"BATT OFF". Check that the 'A' system and *
  *'B' system BATT ISOLATE captions are      *
  *illuminated.  IF -                        *
  *******************************************
                |    |
```

```
                |    |
                |    |
                |    |    ------------------------------------
                OK   NOT OK------|'A' or 'B' system BATT ISOLATE    |
                |                |caption remains extinguished -    |
                |                |Chart 114.                        |
                |                 ------------------------------------
                |
N.*******************************************
  *Switch off and disconnect electrical     *
  *ground power as detailed in 24-41-00.    *
  *******************************************
```

4. Trouble Shooting - Emergency Generation - Preliminary (Including Auto-shed Breaker)

```
A.*******************************************
  *Prepare to Trouble Shoot (Ref. para.2.C.).*
  *Observe No.1 engine HP rpm (N2) indicator *
  *on the pilots' centre instrument panel,   *
  *6-211.  Remove the safety clip and reset  *
  *the ENG 1 MAIN THROT SUP circuit breaker  *
  *1K1 on panel 2-213, map ref.F12, checking *
  *that the pointer on No.1 engine HP RPM    *
  *(N2) indicator moves up to and remains at *
  *a dial reading of approximately 65 per    *
  *cent N2.  IF -                            *
  *******************************************
                |    |
                |    |    ------------------------------------
                |    |   |No.1 engine HP rpm (N2) indicator |
                OK   NOT OK------|fails to provide a steady reading |
                |                |of approximately 65 per cent N2 - |
                |                |refer to Trouble Shooting of the  |
                |                |LP(N1) and HP(N2) rpm Indication  |
                |                |system (Ref. 71-00-36).           |
                |                 ------------------------------------
                |
B.*******************************************
  *With the reading of No.1 engine HP rpm    *
  *(N2) indicator at approximately 65 per    *
  *cent N2, check that the emergency         *
  *generator SELECTED and FAIL captions are  *
  *extinguished, and the ASB position        *
  *magnetic indicator changes from cross-line*
  *to in-line.  IF -                         *
  *******************************************
                |    |
```

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
  |     |
  |     |     ------------------------------------
  |     |    |1. SELECTED and FAIL captions       |
  OK    NOT OK------|   remain illuminated and ASB    |
  |          |   position magnetic indicator       |
  |          |   remains cross-line - check for    |
  |          |   28 V d.c. at terminal 2 of CB     |
  |          |   (145). If present, *renew Engine|
  |          |   Speed Unit (95); if not present,|
  |          |   renew CB (145).                   |
  |          |2. ASB position magnetic indicator  |
  |          A   in-line but SELECTED and FAIL     |
  |          |   captions remain illuminated -     |
  |          |   - *renew Engine Speed Unit (95).|
  |          |3. SELECTED and FAIL captions       |
  |          |   illuminated but ASB position      |
  |          |   indicator remains cross-line -    |
  |          |   Chart 115.                        |
  |           ------------------------------------
  |
C.*******************************************
 *Trip the ENG 1 MAIN THROT SUP circuit      *
 *breaker 1K1 on panel 2-213, map ref.F12,   *
 *and check that when the reading on No.1    *
 *engine HP rpm (N2) indicator falls below   *
 *approximately 58 per cent N2, the          *
 *emergency generator SELECTED and FAIL      *
 *captions are illuminated, and the ASB      *
 *position magnetic indicator changes from   *
 *in-line to cross-line. IF -                *
 *******************************************
  |     |
  |     |     ------------------------------------
  |     |    |1. SELECTED and FAIL captions       |
  OK    NOT OK------|   remain extinguished and ASB   |
  |          |   position magnetic indicator       |
  |          |   remains in-line - renew Engine    |
  |          |   Speed Unit (95).                  |
```

2. ASB position magnetic indicator cross-line but SELECTED and FAIL captions remain illuminated - renew Engine Speed Unit (95).
3. SELECTED and FAIL captions extinguished but ASB position magnetic indicator remains in-line - trip CB (145) and check if indicator moves to cross-line. If YES, renew Engine Speed Unit (95); if NO, renew ASB Position Magnetic Indicator (101).

D. Fit a safety clip to the circuit breaker tripped in operation C. Disconnect the throttle system test set cable 2 connector from connector socket SKT 2 on No.1 engine main control amplifier and reconnect it to connector socket SKT 2 on the front of No.2 engine main control amplifier (2K20). Observe No.2 engine HP rpm (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP rpm (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2. IF -

OK

NOT OK------ No.2 engine HP rpm (N2) indicator fails to provide a steady reading of approximately 65 per cent N2 - refer to Trouble Shooting of the LP (N1) and HP (N2) rpm Indication system (Ref. 71-00-36).

```
          |
E.********************************************
  *With the reading on No.2 engine HP rpm    *
  *(N2) indicator at approximately 65 per    *
  *cent N2, check that the emergency         *
  *generator SELECTED and FAIL captions are  *
  *extinguished, and the ASB position        *
  *magnetic indicator changes from cross-line*
  *to in-line.  IF -                         *
  ********************************************
          |    |
          |    |                    -----------------------------------
          |    |               |SELECTED and FAIL captions remain |
          OK   NOT OK------|illuminated and ASB position       |
          |                    |magnetic indicator remains in-line |
          |                    |- *renew Engine Speed Unit (95).   |
          |                     -----------------------------------
          |
F.********************************************
  *Set, in turn, Nos.1, 2, 3 and 4 essential/*
  *main (NORM/EMERG) control switches to     *
  *"EMERG" and then return to "NORM". Check  *
  *that when any one switch is at EMERG the  *
  *associated essential/main isolate magnetic*
  *indicator displays cross-line, the        *
  *associated AC ESS BUS caption is illumi-  *
  *nated, and the emergency generator FAIL   *
  *and SELECTED captions are illuminated.    *
  *IF -                                      *
  ********************************************
          |    |
          |    |                    -----------------------------------
          |    |               |1. An essential/main isolate      |
          OK   NOT OK------|   magnetic indicator remains in-  |
          |                    |   line with the associated essen- |
          |                    |   tial/main control switch set to |
          |                    |   EMERG - Chart 116.              |
          |                    |2. All indications remain unchanged|
          |                    |   when an essential/main control  |
          |                    |   switch is set to EMERG, or if   |
          |                    |   the AC ESS BUS, SELECTED and    |
          |                    |   FAIL captions remain illuminated|
          |                    |   when essential/main control     |
          |                    |   switch is returned to NORM -    |
          |                    |   renew Essential/Main Control    |
          |                    |   switch (50), (51), (52) or (53).|
          |                     -----------------------------------
          |
```

```
                     |
G.********************************************
  *Trip the ENG 2 MAIN THROT SUP circuit     *
  *breaker 2K1 on panel 2-213, map ref.C12,  *
  *and check that when the reading on No.2   *
  *engine HP rpm (N2) indicator falls below  *
  *approximately 58 per cent N2 the          *
  *emergency generator SELECTED and FAIL     *
  *captions are illuminated, and the ASB     *
  *position magnetic indicator changes from  *
  *in-line to cross-line. IF -               *
  ********************************************
               |    |
               |    |          -----------------------------------
               |    |         |SELECTED and FAIL captions remain  |
              OK   NOT OK------|extinguished and ASB position mag-
               |              |netic indicator remains in-line -  |
               |              |renew Engine Speed Unit (95).      |
               |               -----------------------------------
               |
```

Before SB 24-023

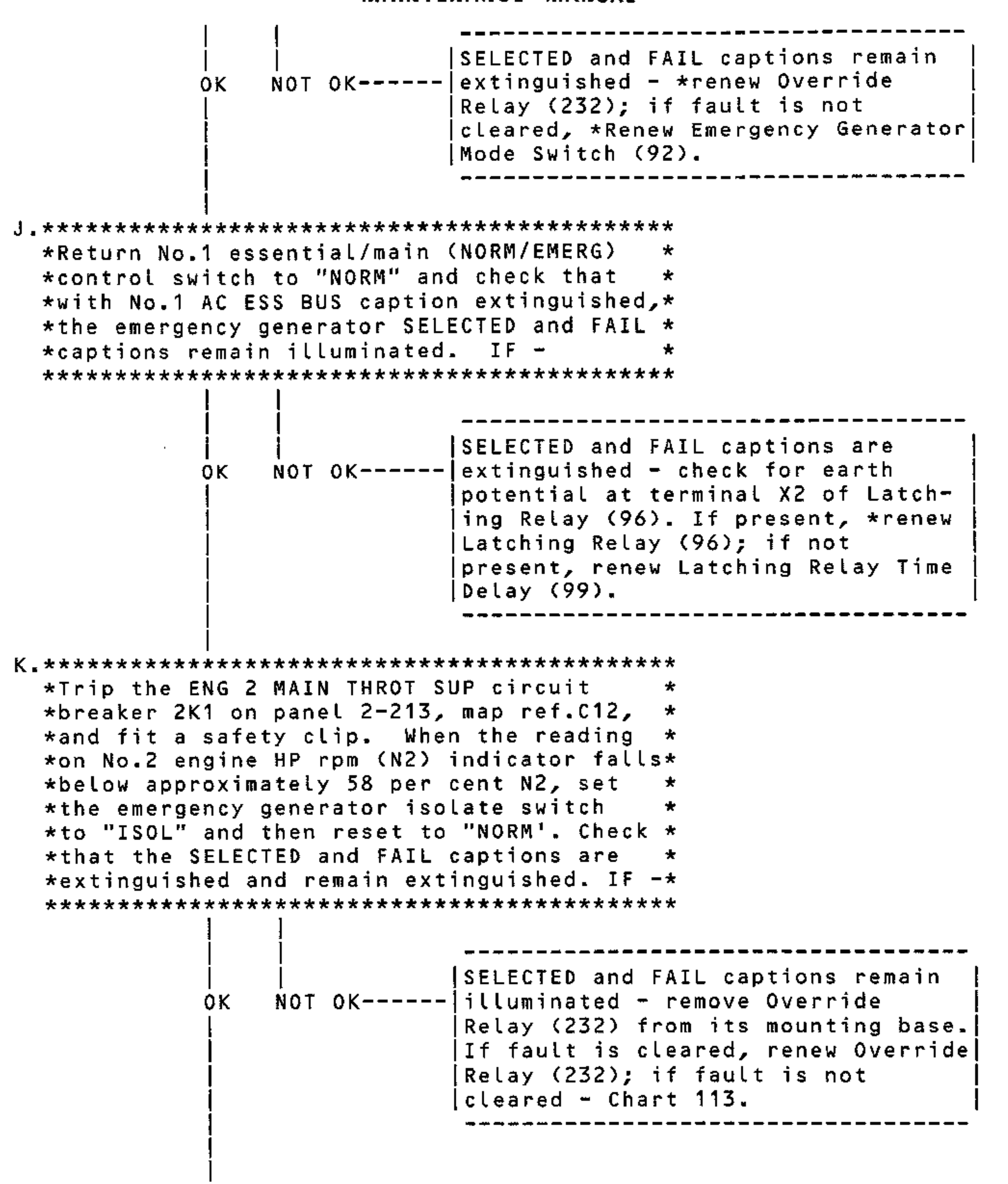
```
H.*********************************************
  *Trip the EMER GEN AUTO CONT circuit        *
  *breaker X212 (93). Fit a safety clip to    *
  *this circuit breaker and to the circuit    *
  *breaker tripped in operation G.            *
  *Disconnect the throttle control system     *
  *test set cable 2 connector from connector  *
  *socket SKT 2 on No.2 engine main control   *
  *amplifier and from connector socket PL 2   *
  *on the test set. Remove the test set, fit  *
  *the captive protection caps to connector   *
  *sockets SKT 2 on Nos.1 and 2 engine main   *
  *control amplifiers and refit the panels    *
  *removed to gain access to shelves 6-215    *
  *and 8-215.                                 *
  *Remove the safety clips and reset the      *
  *ENG 1 MAIN THROT SUP circuit breaker 1K1   *
  *on panel 2-213, map ref.F12, and the ENG 2 *
  *MAIN THROT SUP circuit breaker 2K1 on      *
  *panel 2-213, map ref.C12. Remove the       *
  *warning placard (Ref. para.2.C.(7).        *
  *Refer to the CAUTION (Ref. para.2.C.);     *
  *then trip the LH UC WEIGHT SW & DOWNLOCK   *
  *'B' SYS SUP circuit breaker G293 on panel  *
  *3-213, map ref.B8, and the RH UC WEIGHT SW *
  *'B' SYS SUP circuit breaker G294 on panel  *
  *3-213, map ref.B9;  fit safety clips.  Set *
  *the emergency generator mode switch to     *
  *"AUTO".  Remove the safety clip from and   *
  *reset the EMER GEN AUTO CONT circuit       *
  *breaker X212 (93);  check that the         *
  *emergency generator SELECTED and FAIL      *
  *captions are illuminated.  IF -            *
  *********************************************
             |    |
             |    |      -------------------------------------
             |    |     |SELECTED and FAIL captions remain   |
            OK   NOT OK-|extinguished - check for 28 V d.c.  |
             |          |at terminal 5 of TB UG2843 on shelf |
             |          |12-215.  If present, *renew         |
             |          |Emergency Generator Mode Switch     |
             |          |(92);  if not present, check for    |
             |          |O/C in wiring between terminal 4 of |
             |          |TB UG2843 and pin 5 of Engine Speed |
             |          |Unit (95).                          |
             |           -------------------------------------
```


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```
I.*******************************************
  *Reset CBs G293 on panel 3-213, map ref.B8,*
  *and G294 on panel 3-213, map ref.B9. Check*
  *that the emergency generator SELECTED and *
  *FAIL captions remain illuminated.  IF -   *
  *******************************************
           |    |
           |    |          -------------------------------------
           |    |         |SELECTED and FAIL captions are       |
           OK   NOT OK------|extinguished when both CBs G293 and|
           |              |G294 are reset - check for earth     |
           |              |potential at terminal X2 of Latch-   |
           |              |ing Relay (96).  If present, *renew  |
           |              |Latching Relay (96); if not          |
           |              |present, renew Latching Relay Time   |
           |              |Delay (99).                          |
           |               -------------------------------------
           |
J.*******************************************
  *Set the emergency generator isolate switch*
  *to "ISOL" and then to "NORM" to extinguish*
  *the SELECTED and FAIL captions.  Ensure   *
  *that the weight switch relay controlled   *
  *services isolated in accordance with the  *
  *provisions of the CAUTION(ref. para.2.C.)*
  *are reinstated as required.               *
  *******************************************
```

After SB 24-023 For A/C 001-004,
012-012, 016-016

```
             |
H.*****************************************
  *Set the emergency generator isolate switch*
  *to "ISOL" and the mode switch to "AUTO",  *
  *then set the isolate switch to "NORM" and *
  *check that the emergency generator        *
  *SELECTED and FAIL captions are            *
  *extinguished.  IF -                       *
  *****************************************
             |    |
             |    |        ------------------------------------
             OK   NOT OK------|SELECTED and FAIL captions remain |
             |                |illuminated - Chart 113.          |
             |                ------------------------------------
             |
I.*****************************************
  *Observe No.2 engine HP rpm indicator on   *
  *the pilots' centre instrument panel 6-211.*
  *Reset the ENG 2 MAIN THROT SUP circuit    *
  *breaker 2K1 on panel 2-213, map ref.C12,  *
  *checking that the pointer on No.2 engine  *
  *HP rpm indicator moves up to and remains  *
  *at a dial reading of approximately 65     *
  *per cent N2. Set No.1 essential/main      *
  *(NORM/EMERG) control switch to "EMERG" and*
  *check that with No.1 AC ESS BUS caption   *
  *illuminated, the emergency generator      *
  *SELECTED and FAIL captions are            *
  *illuminated.  IF -                        *
  *****************************************
             |    |
```



```
      |     |                 ----------------------------------
      |     |                |SELECTED and FAIL captions remain |
      OK    NOT OK-----------|extinguished - *renew Override    |
      |                      |Relay (232); if fault is not      |
      |                      |cleared, *Renew Emergency Generator|
      |                      |Mode Switch (92).                 |
      |                       ----------------------------------
      |
J.*********************************************
  *Return No.1 essential/main (NORM/EMERG)    *
  *control switch to "NORM" and check that    *
  *with No.1 AC ESS BUS caption extinguished,*
  *the emergency generator SELECTED and FAIL *
  *captions remain illuminated.  IF -         *
  *********************************************
      |     |
      |     |                 ----------------------------------
      |     |                |SELECTED and FAIL captions are    |
      OK    NOT OK-----------|extinguished - check for earth    |
      |                      |potential at terminal X2 of Latch-|
      |                      |ing Relay (96). If present, *renew|
      |                      |Latching Relay (96); if not       |
      |                      |present, renew Latching Relay Time|
      |                      |Delay (99).                       |
      |                       ----------------------------------
      |
K.*********************************************
  *Trip the ENG 2 MAIN THROT SUP circuit      *
  *breaker 2K1 on panel 2-213, map ref.C12,   *
  *and fit a safety clip.  When the reading   *
  *on No.2 engine HP rpm (N2) indicator falls*
  *below approximately 58 per cent N2, set    *
  *the emergency generator isolate switch     *
  *to "ISOL" and then reset to "NORM'. Check *
  *that the SELECTED and FAIL captions are    *
  *extinguished and remain extinguished. IF -*
  *********************************************
      |     |
      |     |                 ----------------------------------
      |     |                |SELECTED and FAIL captions remain |
      OK    NOT OK-----------|illuminated - remove Override     |
      |                      |Relay (232) from its mounting base.|
      |                      |If fault is cleared, renew Override|
      |                      |Relay (232); if fault is not      |
      |                      |cleared - Chart 113.              |
      |                       ----------------------------------
      |
```

```
             OK
              |
L.*********************************************
  *Trip the EMER GEN AUTO CONT circuit        *
  *breaker X212 (93), and fit a safety clip.  *
  *Disconnect the throttle control system     *
  *test set cable 2 connector from connector  *
  *socket SKT 2 on No.2 engine main control   *
  *amplifier and from connector socket PL 2   *
  *on the test set. Remove the test set, fit  *
  *the captive protection caps to connector   *
  *sockets SKT 2 on Nos.1 and 2 engine main   *
  *control amplifiers and refit the panels    *
  *removed to gain access to shelves 6-215    *
  *and 8-215.                                 *
  *Remove the safety clips and reset the      *
  *ENG 1 MAIN THROT SUP circuit breaker 1K1   *
  *on panel 2-213, map ref.F12, and the ENG 2 *
  *MAIN THROT SUP circuit breaker 2K1 on      *
  *panel 2-213, map ref.C12. Remove the       *
  *warning placard (Ref. para.2.C.(7)).       *
  *Refer to the CAUTION (Ref. para.2.C.);     *
  *then trip the LH UC WEIGHT SW & DOWNLOCK   *
  *'B' SYS SUP circuit breaker G293 on panel  *
  *3-213, map ref.B8, and the RH UC WEIGHT SW *
  *'B' SYS SUP circuit breaker G294 on panel  *
  *3-213, map ref.B9;  fit safety clips.  Set *
  *the emergency generator mode switch to     *
  *"AUTO".  Remove the safety clip from and   *
  *reset the EMER GEN AUTO CONT circuit       *
  *breaker X212 (93); check that the          *
  *emergency generator SELECTED and FAIL      *
  *captions are illuminated.  IF -            *
  *********************************************
              |    |
              |    |                 ------------------------------------
              |    |                |SELECTED and FAIL captions remain   |
             OK   NOT OK------------|extinguished - check for 28 V d.c.  |
              |                     |at terminal 5 of TB UG2843 on shelf |
              |                     |12-215.  If present, *renew         |
              |                     |Emergency Generator Mode Switch     |
              |                     |(92);  if not present, check for    |
              |                     |O/C in wiring between terminal 4 of |
              |                     |TB UG2843 and pin 5 of Engine Speed |
              |                     |Unit (95).                          |
              |                      ------------------------------------
```

```
                  |
                  |
M.*******************************************
  *Reset CBs G293 on panel 3-213, map ref.B8,*
  *and G294 on panel 3-213, map ref.B9. Check*
  *that the emergency generator SELECTED and *
  *FAIL captions remain illuminated.  IF -   *
  *******************************************
                  |    |
                  |    |                -----------------------------------
                  |    |               |SELECTED and FAIL captions are     |
                  OK   NOT OK------|extinguished when both CBs G293 and|
                  |                    |G294 are reset - check for earth   |
                  |                    |potential at terminal X2 of Latch- |
                  |                    |ing Relay (96).  If present, *renew|
                  |                    |Latching Relay (96); if not        |
                  |                    |present, renew Latching Relay Time |
                  |                    |Delay (99).                        |
                  |                     -----------------------------------
                  |
                  |
N.*******************************************
  *Set the emergency generator isolate switch*
  *to "ISOL" and then to "NORM" to extinguish*
  *the SELECTED and FAIL captions.  Ensure   *
  *that the weight switch relay controlled   *
  *services isolated in accordance with the  *
  *provisions of the CAUTION (Ref. para.2.C.)*
  *are reinstated as required.               *
  *******************************************
```

R **ON A/C 001-006,

5. Trouble Shooting - Emergency Generator Overheat Indication

A. Prepare to trouble shoot (Ref. para.2.D.). Progressively increase the resistance on the resistance box connected between pins A and B. Check that the emergency generator O/HEAT caption and the master warning red ELEC caption are illuminated when the resistance setting is within the range 162 to 167 ohm. Reset the resistance box to 100 ohm and check that the O/HEAT caption and the master warning red ELEC caption are extinguished. IF -

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK:

1. O/HEAT caption fails to become illuminated - press-to-test O/HEAT caption. If caption is then illuminated, *renew Temperature Controlled Relay (102). If caption remains extinguished, *renew Emergency Generator O/HEAT Caption Light Module (103).
2. O/HEAT caption is illuminated but the master warning red ELEC caption is not illuminated - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00).
3. O/HEAT caption fails to become extinguished when resistance is decreased - renew Temperature Controlled Relay (102).

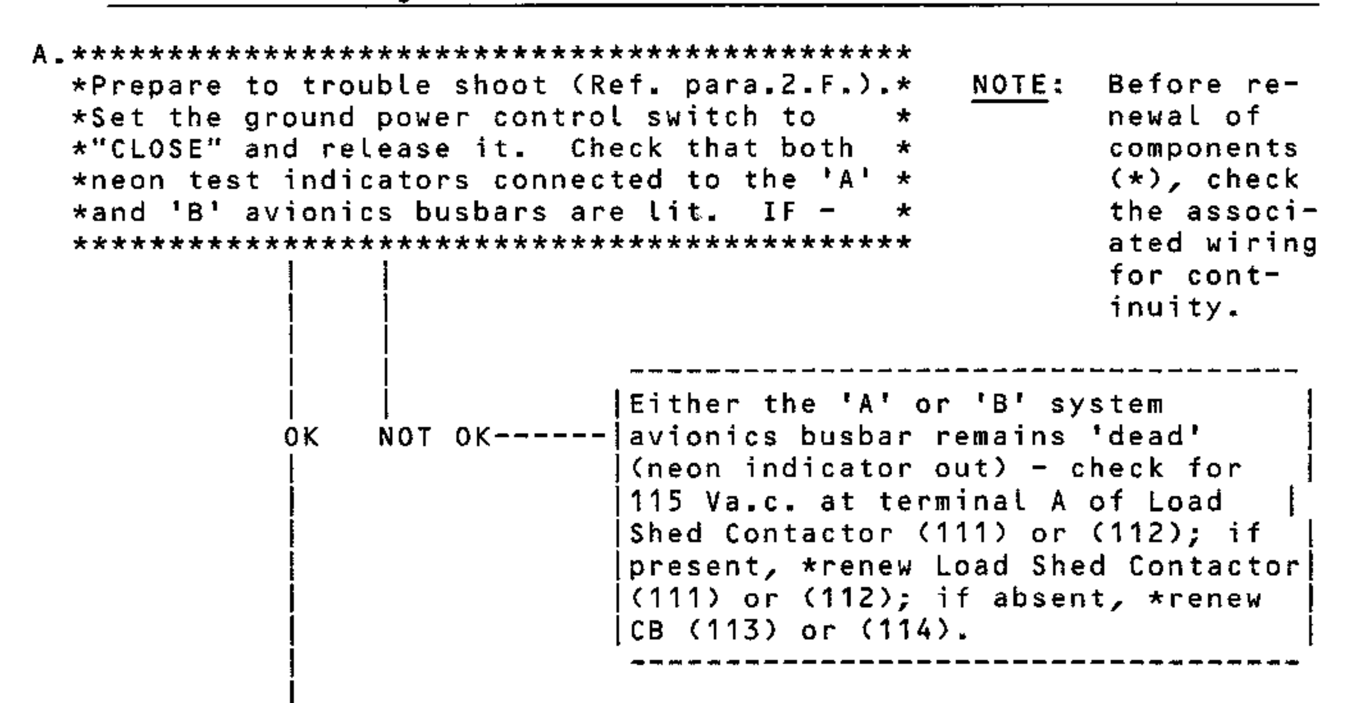
```
    |
B.********************************************
  *Progressively increase the resistance on  *
  *the resistance box connected between pins *
  *G and H.  Check that the O/HEAT caption   *
  *and the master warning red ELEC caption   *
  *are illuminated when the resistance       *
  *setting is within the range 162 to 167    *
  *ohm. Reset the resistance box to 100 ohm  *
  *and check that the O/HEAT caption and the *
  *master warning red ELEC caption are       *
  *extinguished.  IF -                       *
  ********************************************
           |    |
           |    |                 -----------------------------------
           |    |                |1. O/HEAT caption fails to become  |
           OK   NOT OK-----------|   illuminated - *renew Temperature|
           |                     |   Controlled Relay (104).         |
           |                     |2. O/HEAT caption fails to become  |
           |                     |   extinguished when resistance is |
           |                     |   decreased - renew Temperature   |
           |                     |   Controlled Relay (104).         |
           |                      -----------------------------------
           |
C.********************************************
  *Extinguish the emergency generator        *
  *SELECTED and FAIL captions by setting the *
  *emergency generator mode switch to "AUTO" *
  *and the isolation switch to "ISOL"; return*
  *the isolation switch to "NORM", trip CB   *
  *(93) and fit a safety clip.  Disconnect   *
  *both decade resistance boxes and reconnect*
  *the electrical connector X200-A to the    *
  *emergency generator.  Refit the access    *
  *door removed in Preparation, remove the   *
  *safety clips and reset CB (93) and CB     *
  *(90).                                     *
  ********************************************
```

6. Trouble Shooting - 26 V 400 Hz AC Generation

```
A.********************************************
  *Prepare to trouble shoot (Ref. para.2.E.).*
  *Set the ground power control switch to    *
  *"CLOSE" and release it.  Check that the   *
  *four test lamps connected to the 26 V a.c.*
  *busbars are lit.  IF -                    *
  ********************************************
             |    |
             |    |      -----------------------------------
             |    |     |1. Both 26 V a.c. 'A' main and      |
             OK   NOT OK|   essential busbars remain 'dead'  |
             |          |   (test lamps out) or both 26 V    |
             |          |   a.c. 'B' main and essential bus- |
             |          |   bars remain 'dead' - Chart 117.  |
             |          |2. Either the 26 V a.c. 'A' or 'B'  |
             |          |   main busbar remains 'dead' (test |
             |          |   lamp out) - renew Load Shed      |
             |          |   Contactor (107) or (108).        |
             |          |3. Either the 26 V a.c. 'A' or 'B'  |
             |          |   essential busbar remains 'dead'  |
             |          |   (test lamp out) - locate and     |
             |          |   rectify O/C between terminal A   |
             |          |   of Load Shed Contactor (107) or  |
             |          |   (108) and terminal 1 on TB       |
             |          |   (UG2737) or (UG2739) behind the  |
             |          |   circuit breaker panels in zone   |
             |          |   213.                             |
             |           -----------------------------------
             |
```

B. *Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG". Check that the test lamps connected to the 26 V a.c. 'A' and 'B' busbars go out.
Return Nos.2 and 3 essential/main (NORM/EMERG) control switches to "NORM". Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on. Trip and fit safety clips to CBs (105) and (106).
Disconnect and remove the four test lamps.
Close and secure the circuit breaker panels. Remove the safety clips and reset CBs (105) and (106). Remove the warning placard from the ground power rig.*

7. Trouble Shooting - 'A' and 'B' Avionics 115 V 400 Hz AC Busbars



A. *Prepare to trouble shoot (Ref. para.2.F.). Set the ground power control switch to "CLOSE" and release it. Check that both neon test indicators connected to the 'A' and 'B' avionics busbars are lit. IF -*

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK — Either the 'A' or 'B' system avionics busbar remains 'dead' (neon indicator out) - check for 115 Va.c. at terminal A of Load Shed Contactor (111) or (112); if present, *renew Load Shed Contactor (111) or (112); if absent, *renew CB (113) or (114).

```
                 |
B.*********************************************
  *Set Nos.2 and 3 essential/main (NORM/      *
  *EMERG) control switches to "EMERG". Check  *
  *that both neon test indicators go out.     *
  *IF -                                       *
  *********************************************
                 |    |
                 |    |     -------------------------------------
                 |    |    |Either the 'A' or 'B' system         |
                 OK   NOT OK------|avionics busbar remains 'live'       |
                 |         |(neon indicator lit) - renew *Load   |
                 |         |Shed Contactor (111) or (112).       |
                 |          -------------------------------------
                 |
                 |
C.*********************************************
  *Return Nos.2 and 3 essential/main (NORM/   *
  *EMERG) control switches to "NORM".  Switch*
  *off the ground power supply at source and *
  *place a warning placard on the ground      *
  *power rig forbidding any attempt to switch*
  *the ground power supply on.  Trip and fit *
  *safety clips to CBs (113)and (114).       *
  *Disconnect and remove the two neon test    *
  *indicators.  Close and secure the circuit *
  *breaker panels.  Remove the safety clips   *
  *and reset CBs (113) and (114).  Remove the*
  *warning placard from the ground power rig.*
  *********************************************
```

8. <u>Trouble Shooting - 115/26 V AC Standby Inverter Supplies and Control</u>

```
A.*********************************************
  *Prepare to trouble shoot (Ref. para.2.G.).*
  *Set the ground power control switch to     *
  *"CLOSE" and release it.  Check that the    *
  *26 V and 115 V busbars are 'live', by      *
  *observing the test lamp and the voltage    *
  *and frequency indications on the test-     *
  *meters (approx. 115 V 400 Hz). IF -        *
  *********************************************
                 |    |
```

NOTE: Before renewal of components (*) check the associated wiring for continuity.

```
        |      |
        |      |             ------------------------------------
        |      |            |1. 26 V and 115 V a.c. standby bus-|
        OK    NOT OK------|   bars are 'dead', i.e., voltage    |
        |                   |   and frequency not indicated on  |
        |                   |   test meters and test lamp re-   |
        |                   |   mains out - check for 115 V a.c.|
        |                   |   output at CB (115); if present, |
        |                   |   *renew Static Inverter Control  |
        |                   |   relay (116);  if not present,   |
        |                   |   renew CB (115).                 |
        |                   |2. 26 V a.c. standby busbar is     |
        |                   |   'dead', i.e., test lamp remains |
        |                   |   out - check for 115 V a.c.      |
        |                   |   output at CB (160); if present  |
        |                   |   *renew 26 V a.c. transformer    |
        |                   |   (119); if not present, *renew CB|
        |                   |   (160).                          |
        |                    ------------------------------------
        |
B.********************************************
  *Set the ground power control switch to    *
  *"TRIP" and release it;  check that the    *
  *indications on the test voltmeter and     *
  *frequency meter fall to zero and the test *
  *lamp goes out.  Trip, and fit a safety    *
  *clip to, CB (115) to isolate the 115 V    *
  *a.c. standby busbar from the No.1 essent- *
  *ial busbar. Set the ground power control  *
  *switch to "CLOSE" and check that the      *
  *indications on the  test voltmeter and    *
  *frequency meter remain at zero and the    *
  *test lamp remains out.  IF -              *
  ********************************************
        |      |
        |      |             ------------------------------------
        |      |            |26 V and 115 V a.c. standby busbars|
        OK    NOT OK------|are 'live' i.e., voltage and       |
        |                   |frequency are indicated on the     |
        |                   |testmeters and the test lamp is    |
        |                   |lit - renew Static Inverter        |
        |                   |Control Relay (116).  Check that   |
        |                   |fault has cleared.  If not, renew  |
        |                   |Ram Air Turbine (RAT) Control      |
        |                   |Switches (117) or (118).           |
        |                    ------------------------------------
        |
```

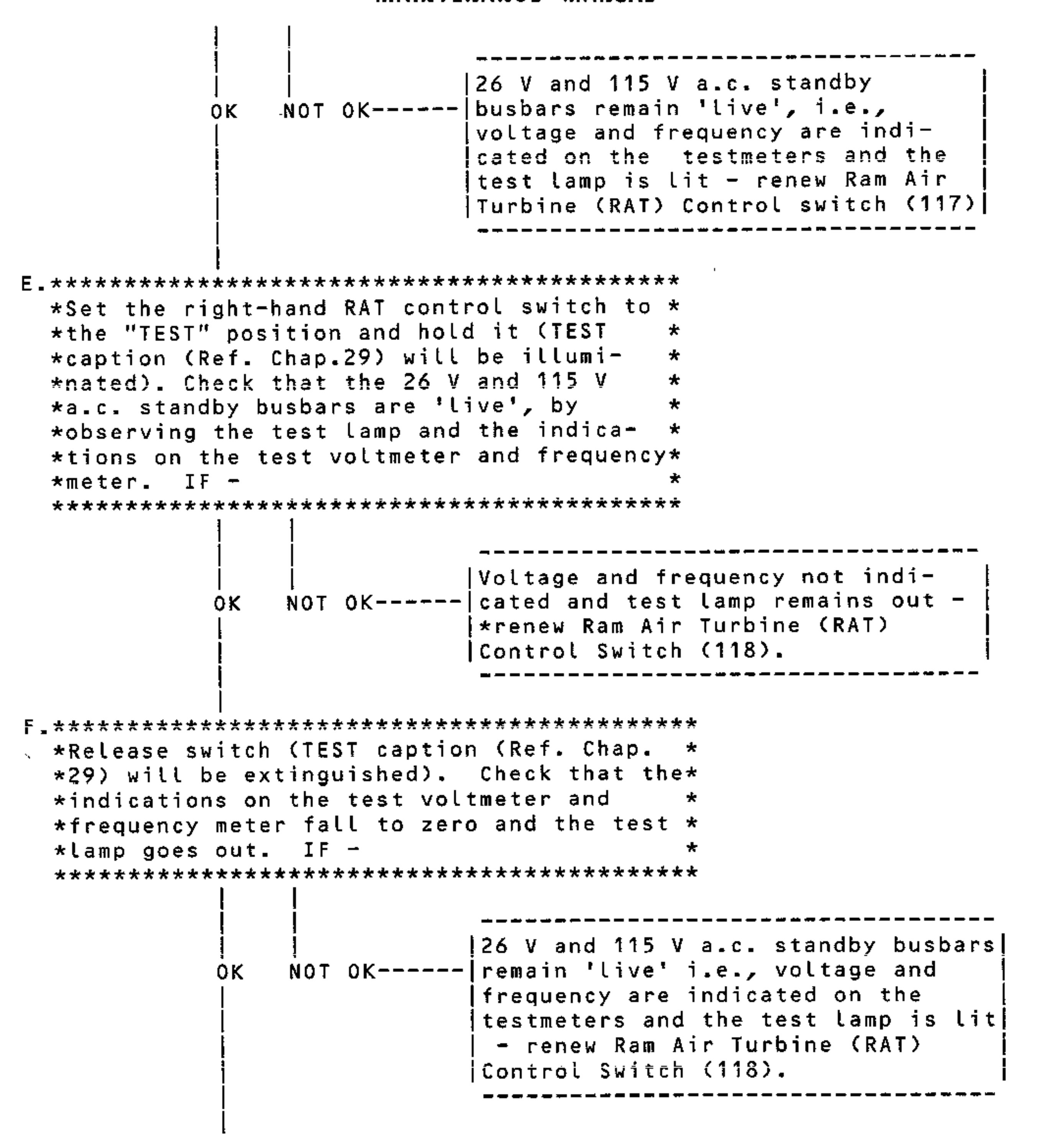
C. ***
*WARNING: THE CONTROL SWITCHES ON THE RAM *
* AIR TURBINE (RAT) CONTROL PANEL *
* ARE EACH GUARDED TO PERMIT OPER-*
* ATION OF A SWITCH TO THE "TEST" *
* POSITION ONLY, AS REQUIRED FOR *
* THE FOLLOWING TEST. *
* *
* THESE GUARDS MUST NOT BE RAISED,*
* SINCE OPERATION OF EITHER SWITCH*
* TO THE "ON" POSITION WILL *
* INITIATE THE AUTOMATIC EXTENSION*
* OF THE RAM AIR TURBINE TO ITS *
* OPERATIONAL POSITION BENEATH THE*
* AIRCRAFT. *
* *
Set left-hand ram air turbine (RAT control
*switch (panel 14-214) to "TEST" and hold *
*in position (TEST caption in panel (Ref. *
Chap.29) will be illuminated). Check that
*the 26 V and 115 V a.c. standby busbars *
are 'live', by observing the test lamp and
*the indications on the test voltmeter and *
frequency meter. Check also that the volt-
*age and frequency of the static inverter *
*so indicated are correct, i.e., *
*115(+5 -8.5) V 400(±8) Hz. IF - *
****

OK

NOT OK

1. 26 V and 115 V a.c. standby busbars remain 'dead', i.e., voltage and frequency not indicated and test lamp remains out - Chart 118.
2. Voltage and/or frequency indications are incorrect - renew Static Inverter (121).

D. ***
*Release switch (TEST caption (Ref. Chap. *
29) will be extinguished). Check that the
*indications on the test voltmeter and *
frequency meter fall to zero and the test
*lamp goes out. IF - *
****



OK — NOT OK → 26 V and 115 V a.c. standby busbars remain 'live', i.e., voltage and frequency are indicated on the testmeters and the test lamp is lit - renew Ram Air Turbine (RAT) Control switch (117)

E. *Set the right-hand RAT control switch to the "TEST" position and hold it (TEST caption (Ref. Chap.29) will be illuminated). Check that the 26 V and 115 V a.c. standby busbars are 'live', by observing the test lamp and the indications on the test voltmeter and frequency meter. IF -

OK — NOT OK → Voltage and frequency not indicated and test lamp remains out - *renew Ram Air Turbine (RAT) Control Switch (118).

F. *Release switch (TEST caption (Ref. Chap. 29) will be extinguished). Check that the indications on the test voltmeter and frequency meter fall to zero and the test lamp goes out. IF -

OK — NOT OK → 26 V and 115 V a.c. standby busbars remain 'live' i.e., voltage and frequency are indicated on the testmeters and the test lamp is lit - renew Ram Air Turbine (RAT) Control Switch (118).

G.
Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power on. Disconnect and remove the test voltmeter and frequency meter and the test lamp. Close and secure circuit breaker panel 2-213. Remove the safety clip and reset CB (115). Remove the warning placard from the ground power rig.

9. Trouble Shooting - DC Essential/Main Split - AC Undervolt Control

A.
Prepare to trouble shoot (Ref. para.2.H.). Set No.1 BTB control switch to "NORM" and then back to "TRIP". Check that both 'A' and 'B' system essential/main split magnetic indicators change from cross-line to in-line, and then back to cross-line. IF -

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK

1. Both essential/main split magnetic indicators remain cross-line - *renew No.1 Main AC Undervolt Unit (21).
2. 'A' system essential main split magnetic indicator remains cross-line. Check and renew as necessary Fuses (126) and/or (127).

```
                  |
                  |
B.**********************************************
  *Set Nos.2 and 4 BTB control switches, in   *
  *turn, to "NORM" and then back to "TRIP".   *
  *Check that both 'A' and 'B' system         *
  *essential/main split magnetic indicators   *
  *change from cross-line to in-line, and     *
  *then back to cross-line with the operation*
  *of each switch.  IF -                      *
  **********************************************
                  |    |
                  |    |                 -----------------------------------
                  |    |                |Both essential/main split magnetic |
                 OK   NOT OK------------|indicators remain cross-line -     |
                  |                     |renew Main AC Undervolt Unit (22)  |
                  |                     |or (24).                           |
                  |                      -----------------------------------
                  |
```

```
                 |
C.*********************************************
  *Set BATT A and BATT B control switches to *
  *"BATT OFF"; ensure associated magnetic    *
  *indicators display cross-line.  Switch off*
  *ground power at source and place a warning*
  *placard on the ground power rig forbidding*
  *any attempt to switch the ground power    *
  *supply 'on'.  Gain access to No.3 Main AC *
  *Undervolt Unit (23). Remove the terminal  *
  *cover and reconnect the earth cable to    *
  *terminal 4 (earth) of the Unit (23),      *
  *checking the order of the terminal        *
  *screw washers. Torque-tighten the terminal*
  *screw to between 12 and 14 lbf in (0.137  *
  *and 0.160 mdaN). Refit the terminal cover.*
  *Close and secure the circuit breaker      *
  *panel. Remove the warning placard, switch *
  *on ground power at source and set the     *
  *ground power control switch to "CLOSE"    *
  *and release it.  Set BATT A and BATT B    *
  *control switches to "BATT ON".  Ensure    *
  *that Nos.1, 2 and 4 BTB control switches  *
  *are at TRIP, No.3 BTB control switch is at*
  *NORM and that No.3 AC MAIN BUS and AC ESS *
  *BUS captions are extinguished.  Check that*
  *both 'A' and 'B' essential/main split     *
  *magnetic indicators display in-line.  IF -*
  *******************************************
            |    |
            |    |          ---------------------------------------
            |    |         |Both essential/main split magnetic   |
            OK   NOT OK------|indicators remain cross-line -       |
            |              |renew Main AC Undervolt Unit (23).   |
            |               ---------------------------------------
            |
D.*********************************************
  *Set Nos.1, 2 and 4 BTB control switches to*
  *"NORM", the DC VOLTS selector switch to   *
  *"MAIN A" or "MAIN B" and the four TRU     *
  *control switches to "ISOL", in turn. Check*
  *that the DC MAIN BUS caption is illumi-   *
  *nated and both 'A' and 'B' essential/main *
  *split magnetic indicators display cross-  *
  *line when the d.c. voltage falls below    *
  *25 V.  IF -                               *
  *******************************************
            |    |
```

```
        |     |
        |     |     ------------------------------------
        |     |    |1. The 'A' system essential/main    |
        OK    NOT OK------|   split magnetic indicator  |
        |              |   displays in-line when the d.c. |
        |              |   voltage falls below 25 V - renew|
        |              |   'A' System Main DC Undervolt   |
        |              |   Unit (124).                    |
        |              |2. The 'B' system essential/main  |
        |              |   split magnetic indicator       |
        |              |   displays in-line when the d.c. |
        |              |   voltage falls below 25 V - renew|
        |              |   'B' System Main DC Undervolt   |
        |              |   Unit (125).
        |               ------------------------------------
        |
E.********************************************
  *Return all four TRU control switches to   *
  *"NORM".  Set BATT A and BATT B control    *
  *switches to "BATT OFF".                   *
  ********************************************
```

10. Trouble Shooting - Main Generation Dormant Circuits

```
A.********************************************
  *Prepare to trouble shoot (Ref. para.2.I.).*
  *Ensure that operation of the SSBs, BTBs,  *
  *and associated controls and indicators has*
  *been checked and cleared in accordance    *
  *with the procedures detailed in paragraph *
  *3. Preliminary.                           *
  *Carry out the applicable operations       *
  *detailed in Adjustment/Test, Table 501, as*
  *applied to No.1 channel.  IF -            *
  *                                          *
  *NOTE:  Switch numbers prefixed 'S' are    *
  *       test set switches.  On the set,    *
  *       switch S1 is identified only by the*
  *       number of engraved positions, i.e.,*
  *       positions 1 - 20; switches S2 to S7*
  *       are identified by corresponding    *
  *       engravings, i.e., SW2 to SW7.  The *
  *       VOLTS readings are those registered*
  *       on the test set voltmeter.         *
  ********************************************
          |     |
```

OK — NOT OK:

1. Adjustment/Test operation 2.(1). With dormant circuit test set switch S1 set to position '7' and the GCB control switch set to ON, the associated GCB position magnetic indicator remains cross-line - Chart 119.
2. Any other particular test results in a failure condition being given - renew No.1 Control and Protection Unit (128).

B. Disconnect the test set from No.1 CPU and repeat test as applied to Nos.2, 3 and 4 CPUs, in turn. IF -

OK — NOT OK:

1. Adjustment/Test operation 2.(1). With dormant circuit test set switch S1 set to position '7' and the GCB control switch set to ON, the associated GCB position magnetic indicator remains cross-line - Chart 119.
2. Any other particular test results in a failure condition being given - renew Control and Protection Unit (129), (130) or (131).

C. Disconnect test set and remove from aircraft. Refit the panels removed for access to the CPUs and remove the warning placard from the electrical generating control panel (Ref. Preparation, paragraph 2.I.).

11. Trouble Shooting - Emergency Generation - Using Hydraulic Ground Power

```
A.*******************************************
 *Prepare to trouble shoot (Ref. para.2.J.).*   NOTE:  Before re-
 *Check that Nos.1, 2, 3 and 4 engine       *          newal of
 *relight busbars 'power on' neon indicator *          components
 *lamps are lit and the emergency generator *          (*), check
 *'power on' neon indicator lamp is         *          the associ-
 *extinguished.  IF -                       *          ated wiring
 *******************************************           for
           |    |                                      continuity.
           |    |
           |    |           ----------------------------------
           |    |          |An engine relight busbar 'power on'|
           OK   NOT OK-----|neon indicator lamp remains out -  |
           |               |Chart 120.                         |
           |                ----------------------------------
           |
B.*******************************************
 *Check that Nos.1, 2, 3 and 4 a.c.         *
 *essential busbar 'power on' neon indicator*
 *lamps are lit.  IF -                      *
 *******************************************
           |    |
           |    |           ----------------------------------
           |    |          |1. An essential busbar neon        |
           OK   NOT OK-----|   indicator lamp remains out with |
           |               |   associated AC ESS BUS caption   |
           |               |   extinguished - renew Neon       |
           |               |   Indicator Lamp (132), (133),    |
           |               |   (134) or (135).                 |
           |               |2. An essential busbar neon        |
           |               |   indicator lamp out with associ- |
           |               |   ated ACESS BUS caption illumin- |
           |               |   ated - check a.c. essential     |
           |               |   busbar 115/200 V supplies; if   |
           |               |   correct, check for 115 V a.c.   |
           |               |   output at CB (136),(137), (138) |
           |               |   or (139);  renew CB or rectify  |
           |               |   O/C as necessary.               |
           |                ----------------------------------
           |
```

```
C.*********************************************
  *Set the AC FREQ/VOLTS selector switch to  *
  *"EMERG PWR".  Set Nos.1,2,3 and 4 essen-  *
  *tial/main (NORM/EMERG) control switches to*
  *"EMERG" (Nos.1,2,3 and 4 AC ESS BUS cap-  *
  *tions will be illuminated). Set the emer- *
  *gency generator mode switch to "MANUAL".  *
  *Check that the emergency generator com-   *
  *mences running, by observing the voltage  *
  *and frequency indications on the associ-  *
  *ated meters (approx. 115 V 400 Hz) and the*
  *emergency generator 'power on' neon indi- *
  *cator.  Check also that Nos.1 and 2 AC    *
  *ESS BUS captions are extinguished, Nos.3  *
  *and 4 AC ESS BUS captions remain illumi-  *
  *nated, the emergency generator voltage and*
  *frequency indications are not fluctuating,*
  *and an emergency generator load is indi-  *
  *cated on the emergency generator KVA      *
  *meter.  IF -                              *
  *********************************************
             |    |
             |    |
             OK   NOT OK
```

NOTE: The associated checks on the initial application of electrical ground power prove the serviceability of of the voltmeter and frequency meter (Ref. 24-41-00).

1. Voltage and frequency not indicated, neon indicator lamp out; if emergency generator FAIL and SELECTED captions are also out - Chart 111.
2. Voltage and frequency not indicated, neon indicator lamp lit, if emergency generator FAIL caption is out and the SELECTED caption is illuminated - *renew AC FREQ/VOLTS Selector Switch (161); if fault not cleared, renew CB (159).

3. Voltage and frequency not indicated, neon indicator lamp out; if emergency generator FAIL and SELECTED captions are illuminated - Chart 121.
4. Voltage and frequency indicated neon indicator lamp out - renew Neon Indicator Lamp (144).
5. Voltage and frequency displayed and neon indicator lamp is lit with the emergency generator FAIL caption illuminated - check that frequency on frequency meter is between 390 and 410 Hz; if YES, renew Emergency Generator Control and Protection Unit (88); if NO, renew Emergency Generator and Drive Unit (162).
6. No load indication on emergency generator KVA meter with all other indications correct - *renew Emergency Generator KVA Meter (49). Check if fault is cleared. If fault not cleared, renew Emergency Generator KVA Meter Current Transformer (227).
7. No.1 or No.2 AC ESS BUS caption is illuminated with all other indications correct - *renew Essential/Main Change-over Contactor (54) or (55).
8. Nos.3 and 4 AC ESS BUS captions are extinguished - renew ASB (100).
9. Emergency generator voltage and/or frequency indications are fluctuating - renew Emergency Generator and Drive Unit (162).

D. *Set Nos.1,2,3 and 4 essential/main (NORM/EMERG) control switches to "NORM" (Nos.1, 2,3 and 4 AC ESS BUS captions will be extinguished).

NOTE: The following procedures require operation of the switches SW1, SW2, SW3, SW5 (probe-operated) and SW4 (push-button) on the emergency generator, control and protection unit (CPU) and observation of the resulting indications on the CPU and the emergency generator indicators on the electrical generating control panel.

Test the overvoltage (OV) generator trip function as follows:-
Press CPU switches SW4 and SW2, both together, hold both depressed for a period of not less than 1.5 s, and then release both switches. Check that the emergency generator is de-excited, i.e., the voltage and frequency indications fall to zero, the FAIL caption is illuminated, and the overvoltage fault indicator on the CPU displays OV. IF -

OK

NOT OK

1. Emergency generator fails to de-excite, i.e., voltage and frequency indications unchanged and FAIL caption not illuminated - renew Emergency Generator Control and Protection Unit (88).
2. Emergency generator is de-excited but overvoltage fault indicator on CPU does not display OV - renew Emergency Generator Control and Protection Unit (88).

```
                |
E.*********************************************
  *Press-to-test the emergency generator     *
  *FAIL caption to reset the generator for   *
  *normal operation.  Check that the FAIL    *
  *caption is extinguished and the output of *
  *the emergency generator is reinstated,    *
  *by observing that the voltage and         *
  *frequency indications are correct         *
  *(approx. 115 V 400 Hz).  IF -             *
  *********************************************
                |    |
                |    |                 -----------------------------------
                |    |                |Emergency generator voltage and    |
                OK   NOT OK------     |frequency indications remain at    |
                |                     |zero and FAIL caption is illumi-   |
                |                     |nated - remove Emergency Generator |
                |                     |Control and Protection Unit (88);  |
                |                     |then reset CB (93) (tripped for CPU|
                |                     |removal), press the FAIL caption   |
                |                     |and check for 28 V d.c. output at  |
                |                     |pin 12 of CPU rack connector       |
                |                     |X201-A; if present, renew Emergency|
                |                     |Generator Control and Protection   |
                |                     |Unit (88); if absent, refit        |
                |                     |Emergency Generator Control and    |
                |                     |Protection Unit (88). Check for    |
                |                     |28 V d.c. output at terminal 2 of  |
                |                     |Diode (231); if absent, *renew     |
                |                     |Diode (231); if present, *renew    |
                |                     |FAIL Caption Light Module (87).    |
                |                      -----------------------------------
                |
F.*********************************************
  *Press and then release the overvoltage    *
  *fault indicator reset switch SW1 on the   *
  *CPU and check that the OV display         *
  *disappears. IF -                          *
  *********************************************
                |    |
                |    |                 ----------------------------------
                |    |                |OV display remains - renew       |
                OK   NOT OK------     |Emergency Generator Control       |
                |                     |and Protection Unit (88).         |
                |                      ----------------------------------
                |
```

```
               |
G.*******************************************
  *Test the differential protection (DP)    *
  *trip function as follows:-               *
  *Press CPU switches SW4 and SW3 both       *
  *together; then release both switches with-*
  *out delay. Check that the emergency gener-*
  *ator is de-excited, i.e., the voltage and*
  *frequency indications fall to zero, the   *
  *FAIL caption is illuminated, and the      *
  *differential protection fault indicator on*
  *the CPU displays DP.  IF -                *
  ********************************************
               |    |
               |    |            ------------------------------------
               |    |           |1. Emergency generator fails to    |
               OK   NOT OK------|   de-excite, i.e., voltage and    |
               |                |   frequency indications unchanged|
               |                |   and FAIL caption not illumi-    |
               |                |   nated - renew Emergency         |
               |                |   Generator Control and           |
               |                |   Protection Unit (88).           |
               |                |2. Emergency generator is de-      |
               |                |   excited but differential        |
               |                |   protection fault indicator on   |
               |                |   CPU does not display DP - renew|
               |                |   Emergency Generator Control and|
               |                |   Protection Unit (88).           |
               |                 ------------------------------------
               |
H.*******************************************
  *Press-to-test the emergency generator FAIL*
  *caption to reset the generator for normal *
  *operation. Check that the FAIL caption is *
  *extinguished and the output of the        *
  *emergency generator is reinstated, by     *
  *observing that the voltage and frequency  *
  *indications are correct (approx. 115 V    *
  *400 Hz).  IF -                            *
  ********************************************
               |    |
               |    |            ------------------------------------
               |    |           |Emergency generator voltage and    |
               OK   NOT OK------|frequency indications remain at    |
               |                |zero and FAIL caption is illumi-   |
               |                |nated - renew Emergency Generator |
               |                |Control and Protection Unit (88). |
               |                 ------------------------------------
               |
```

```
                  |
I.********************************************
  *Press and then release the differential  *
  *protection fault indicator reset switch  *
  *SW5 on the CPU and check that the DP     *
  *display disappears. IF -                 *
  ********************************************
                  |    |
                  |    |    ---------------------------------
                  |    |   |DP display remains - renew       |
                  OK   NOT OK------|Emergency Generator Control and |
                  |             |Protection Unit (88).           |
                  |             ---------------------------------
                  |
J.*********************************************
  *Trip and fit safety clips to CBs (140),   *
  *(141),(142) and (143) (Nos.1, 2, 3 and 4  *
  *engine relight 'power on' neon indicator  *
  *lamps will be extinguished).  Select      *
  *positions "2", "4", "3" amd "1", in turn, *
  *at the EMERG RELIGHT BUSBAR selector      *
  *switch.  Check that at each position, the *
  *associated engine relight busbar 'power   *
  *on' neon indicator lamp is lit.  IF -     *
  *********************************************
                  |    |
                  |    |    -----------------------------------
                  |    |   |1. Nos.2 and 3 'power on' neon      |
                  OK   NOT OK------|   indicator lamps remain out -     |
                  |             |   check for 115 V a.c. output at   |
                  |             |   CB (158).  If present, renew CB  |
                  |             |   (145); if absent, renew CB       |
                  |             |   (158).                           |
                  |             |2. Nos.1 and 4 'power on' neon      |
                  |             |   indicator lamps remain out -     |
                  |             |   check for 115 V a.c. output at   |
                  |             |   CB (157);  if present, renew CB  |
                  |             |   (146); if absent, renew CB       |
                  |             |   (157).                           |
                  |             |3. One 'power on' neon indicator    |
                  |             |   lamp remains out - check for 28  |
                  |             |   28 V d.c. at terminal X1 of      |
                  |             |   associated Relight Change-over   |
                  |             |   Contactor (147), (148), (149)    |
                  |             |   or (150).  If present, *renew    |
                  |             |   relight change-over contactor;   |
                  |             |   if absent, *renew EMERG RELIGHT  |
                  |             |   BUSBAR Selector Switch (151).    |
                  |             -----------------------------------
```

```
              |
K.********************************************
  *Set the EMERG RELIGHT BUSBAR selector     *
  *switch to "OFF".  Check that all four     *
  *engine relight 'power on' neon indicator  *
  *lamps are out.  IF -                      *
  ********************************************
              |    |
              |    |                ------------------------------------
              |    |               |An engine relight 'power on' neon  |
             OK   NOT OK------|indicator lamp remains lit - renew |
              |                    |Relight Change-over Contactor (147)|
              |                    |(148), (149) or (150).             |
              |                     ------------------------------------
              |
L.********************************************
  *Set the emergency generator isolate switch*
  *to "ISOL".  Check that the emergency      *
  *generator ceases to run, by observing that*
  *the voltage and frequency indications fall*
  *to zero.  IF-                            *
  ********************************************
              |    |
              |    |                ------------------------------------
              |    |               |Emergency generator continues to   |
             OK   NOT OK------|run - renew Hydraulic Selector     |
              |                    |Valve (152).                       |
              |                     ------------------------------------
              |
M.********************************************
  *Set the emergency generator mode switch to*
  *"AUTO" and the isolate switch to "NORM".  *
  *Remove the safety clips and reset CBs     *
  *(140), (141), (142) and (143);  check that*
  *all four engine relight busbar 'power on' *
  *neon indicator lamps light.  Switch off   *
  *and disconnect the ground hydraulic supply*
  *(Ref. Chap.29).  Switch off the ground    *
  *power supply at source.  Close and secure *
  *circuit breaker panels 1-213, 3-213 and   *
  *4-213. Fit the rear vestibule LH          *
  *electronic racking forward and decor      *
  *bulkheads (Ref. 25-71-00).                *
  ********************************************
```

R **ON A/C 001-006,

12. Trouble Shooting - AC and DC Generation Master Warning

A.***
Prepare to trouble shoot (Ref. para.2.K.).
*Apply the following master warning (M/W) *
*test procedures to each caption, NO.1 AC *
*MAIN BUS, NO.2 AC MAIN BUS, NO.3 AC MAIN *
*BUS, NO.4 AC MAIN BUS, DC MAIN BUS, 'A' *
*BATT ISOLATE, and 'B' BATT ISOLATE, in *
*turn:- *
*(a) Press the face of the caption and *
* check that the caption is illuminated,*
* the amber ELEC caption on the M/W *
* display panel is illuminated and the *
* audio warning (single-stroke gong) *
* sounds. *
*(b) Release the face of the caption and *
* check that the caption is extinguished*
* and the amber ELEC caption on the M/W *
* display panel is extinguished. IF - *
****

NOTE: Before renewal of components (*), check the associated wiring for continuity.

OK

NOT OK

1. When an AC MAIN BUS, DC MAIN BUS or BATT ISOLATE caption is pressed, the caption is not illuminated, the M/W amber ELEC caption is not illuminated and no audio warning is given - check for 28 V d.c. output at the associated supply CB; (25), (26), (27) or (28) for AC MAIN BUS captions; (77) for DC MAIN BUS caption; (84) or (85) for BATT ISOLATE captions. If absent, renew Circuit Breaker (25), (26), (27), (28), (77), (84) or (85). If present, *renew AC MAIN BUS Caption Light Module (17), (18), (19) or (20) or DC MAIN BUS Caption Light Module (76) or BATT ISOLATE Caption Light Module (3) or (4).
2. When an AC MAIN BUS, DC MAIN BUS or BATT ISOLATE caption is pressed, the caption is illuminated, but the M/W amber ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).
3. When released after satisfactory operation, an AC MAIN BUS, DC MAIN BUS or BATT ISOLATE caption remains illuminated - renew AC MAIN BUS Caption Light Module (17), (18), (19) or (20) or DC MAIN BUS Caption Light Module (76) or BATT ISOLATE Caption Light Module (3) or (4).

```
                  |
B.*********************************************
  *Apply the following test procedures to    *
  *Nos.1, 2, 3 and 4 bus-tie breaker (BTB)   *
  *control switches, in turn -               *
  *(a) Set the BTB control switch to "TRIP". *
  *    Check that the associated AC MAIN BUS *
  *    and AC ESS BUS captions are illumin-  *
  *    ated, the amber ELEC and red ELEC     *
  *    captions on the M/W display panel are *
  *    illuminated and the audio warning     *
  *    (single-stroke gong) sounds.          *
  *(b) Return the BTB control switch to      *
  *    "NORM".  Check that the associated AC *
  *    MAIN BUS and AC ESS BUS captions are  *
  *    extinguished and the amber ELEC and   *
  *    red ELEC captions on the M/W display  *
  *    panel are extinguished.  IF -         *
  *******************************************
                  |    |
                  |    |        -----------------------------------
                  |    |       |1. With BTB control switch at TRIP,|
                 OK   NOT OK---|   the associated AC MAIN BUS and/ |
                  |            |   or AC ESS BUS caption(s)        |
                  |            |   remain(s) extinguished - check  |
                  |            |   the operation of the BTB control|
                  |            |   switch and associated indicators|
                  |            |   within Preliminary (Ref.        |
                  |            |   para.3.).                       |
                  |            |2. With BTB control switch at TRIP,|
                  |            |   the associated AC MAIN BUS and  |
                  |            |   AC ESS BUS captions are illumin-|
                  |            |   ated but the M/W amber ELEC and/|
                  |            |   or red ELEC captions are not    |
                  |            |   illuminated and/or no audio     |
                  |            |   warning is given - refer to     |
                  |            |   Trouble Shooting of the Master  |
                  |            |   Warning System (Ref. 33-15-00)  |
                  |            |   and/or the Audio Warning System |
                  |            |   (Ref. 31-23-00).                |
```

3. With BTB control switch returned to NORM, the associated AC MAIN, BUS and/or AC ESS BUS captions remain illuminated (the M/W amber ELEC and/or red ELEC caption remains illuminated) - check the operation of the BTB control switch and associated indicators within Preliminary (Ref. para.3.).

C. Trip the 'A' SYS MAIN U/VOLT UNIT SUP circuit breaker 1P13 on panel 15-215, map ref.A2. Check that the DC MAIN BUS caption is illuminated and the audio warning (single-stroke gong) sounds. IF -

OK

NOT OK

1. The DC MAIN BUS caption remains extinguished - *renew 'A' System Main DC Undervolt Unit (124).
2. The DC MAIN BUS caption is illuminated but the M/W ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).

```
               |
D.*********************************************
 *Reset the 'A' SYS MAIN U/V UNIT SUP        *
 *circuit breaker 1P13 on panel 15-215, map  *
 *ref.A.2. Check that the DC MAIN BUS        *
 *caption is extinguished and the M/W amber  *
 *ELEC caption is extinguished. Apply the    *
 *following test procedures to 'A' and 'B'   *
 *battery control switches, in turn:-        *
 *(a) Set the battery control switch to      *
 *    "BATT OFF".  Check that the associated*
 *    BATT ISOLATE caption is illuminated,   *
 *    the M/W amber ELEC caption is          *
 *    illuminated and the audio warning      *
 *    (single-stroke gong) sounds.           *
 *(b) Return the battery control switch to   *
 *    "BATT ON".  Check that the associated  *
 *    BATT ISOLATE caption is extinguished   *
 *    and the M/W amber ELEC caption is      *
 *    extinguished.  IF -                    *
 *********************************************
              |    |
              |    |     -----------------------------------
              |    |    |1. With battery control switch at  |
              OK   NOT OK------|   BATT OFF, the associated BATT    |
              |         |   ISOLATE caption remains exting- |
              |         |   uished - check the operation of |
              |         |   the battery control switch and  |
              |         |   associated indicators within    |
              |         |   Preliminary (Ref. para.3.).     |
              |         |2. With battery control switch at  |
              |         |   BATT OFF, the associated BATT   |
              |         |   ISOLATE caption is illuminated  |
              |         |   but the M/W amber ELEC caption  |
              |         |   is not illuminated and/or no    |
              |         |   audio warning is given - refer  |
              |         |   to Trouble Shooting of the      |
              |         |   Master Warning System (Ref.     |
              |         |   33-15-00) and/or the Audio      |
              |         |   Warning System (Ref. 31-23-00). |
```

3. With battery control switch returned to BATT ON, the associated BATT ISOLATE caption remains illuminated, (the M/W amber ELEC caption remains illuminated) - check the operation of the battery control switch and associated indicators within Preliminary (Ref. para. 3.).

E. *Press the RECALL button on the M/W display panel and ensure that the red ELEC and amber ELEC captions remain extinguished; some other M/W captions may be illuminated. Press the face of all other captions on the M/W panel that are illuminated and check that each is extinguished (warning cancelled).
Apply the following master warning (M/W) test procedures to each caption, No.1 AC ESS BUS, No.2 AC ESS BUS, NO.3 AC ESS BUS, No.4 AC ESS BUS, 'A' system DC ESS BUS, and 'B' system DC ESS BUS, in turn:-
(a) Press the face of the caption and check that the caption is illuminated, the red ELEC caption on the M/W display panel is illuminated and the audio warning (single-stroke gong) sounds.
(b) Release the face of the caption and check that the caption is extinguished and the red ELEC caption on the M/W display panel is extinguished. IF -

OK

NOT OK ------ 1. When an AC ESS BUS or DC ESS BUS caption is pressed, the caption is not illuminated, the M/W red ELEC caption is not illuminated and no audio warning is given - *renew AC ESS BUS Caption Light Module (45), (46), (47) or (48) or DC ESS BUS Caption Light Module (79) or (80).

2. When an AC ESS BUS or DC ESS BUS caption is pressed, the caption is illuminated, but the M/W red ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).
3. When released after satisfactory operation, an AC ESS BUS or DC ESS BUS caption remains illuminated - renew AC ESS BUS Caption Light Module (45), (46), (47) or (48) or DC ESS BUS Caption Light Module (79) or (80).

F. Trip the 'A' ESS U/VOLT UNIT SUP circuit breaker 1P26 on panel 1-213, map ref.M8. Check that the 'A' system DC ESS BUS caption is illuminated, the M/W red ELEC caption is illuminated and the audio warning (single-stroke gong) sounds. IF -

OK

NOT OK

1. The 'A' system DC ESS BUS caption remains extinguished - *renew 'A' System Essential Undervolt Relay (81).
2. The 'A' system DC ESS BUS caption is illuminated but the M/W red ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).

```
                  |
G.*********************************************
  *Reset the 'A' ESS U/VOLT UNIT SUP circuit *
  *breaker 1P26 on panel 1-213, map ref.M8.  *
  *Check that the 'A' system DC ESS BUS      *
  *caption is extinguished and the M/W red   *
  *ELEC caption is extinguished.  Trip the   *
  *'B' ESS U/VOLT UNIT SUP circuit breaker   *
  *2P26 on panel 3-213, map ref.E12. Check   *
  *that the 'B' system DC ESS BUS caption is *
  *illuminated, the M/W red ELEC caption is  *
  *illuminated and the audio warning (single-*
  *stroke gong) sounds.  IF -                *
  *******************************************
                  |    |
                  |    |          -----------------------------------
                  |    |         |1. The 'B' system DC ESS BUS         |
                  OK   NOT OK----|   caption remains extinguished -    |
                  |              |   *renew 'B' System Essential       |
                  |              |   Undervolt Relay (83).             |
                  |              |2. The 'B' system DC ESS BUS         |
                  |              |   caption is illuminated but the    |
                  |              |   M/W red ELEC caption is not       |
                  |              |   illuminated and/or no audio       |
                  |              |   warning is given - refer to       |
                  |              |   Trouble Shooting of the Master    |
                  |              |   Warning System (Ref. 33-15-00)    |
                  |              |   and/or the Audio Warning System   |
                  |              |   (Ref. 31-23-00).                  |
                  |               -----------------------------------
                  |
H.*********************************************
  *Reset the 'B' ESS U/VOLT SUP circuit      *
  *breaker 2P26 on panel 3-213, map ref.E12. *
  *Check that the 'B' system DC ESS BUS      *
  *caption is extinguished and the M/W red   *
  *ELEC caption is extinguished.  Apply the  *
  *following master warning (M/W) test      *
  *procedure to the emergency generator      *
  *O/HEAT caption:-                          *
```

```
*(a) Press the face of the caption and     *
*    check that the caption is illuminated,*
*    the red ELEC caption on the M/W       *
*    display panel is illuminated and the  *
*    audio warning (single-stroke gong)    *
*    sounds.                               *
*(b) Release the face of the caption and   *
*    check that the caption is extinguished*
*    and the red ELEC caption on the M/W   *
*    display panel is extinguished.  IF -  *
********************************************
           |    |
           |    |    ------------------------------------
           |    |   |1. When the O/HEAT caption is      |
          OK   NOT OK------|  pressed the caption is not |
           |        |   illuminated, the M/W red ELEC   |
           |        |   caption is not illuminated, and |
           |        |   no audio warning is given -     |
           |        |   *renew the Emergency Generator  |
           |        |   Caption Light Module (103).     |
           |        |2. When the O/HEAT caption is      |
           |        |   pressed, the caption is illumin-|
           |        |   ated, but the M/W red ELEC      |
           |        |   caption is not illuminated and/ |
           |        |   or no audio warning is given -  |
           |        |   refer to Trouble Shooting of the|
           |        |   Master Warning System (Ref.     |
           |        |   33-15-00) and/or the Audio      |
           |        |   Warning System (Ref. 31-23-00). |
           |        |3. When released after satisfactory|
           |        |   operation, the O/HEAT caption   |
           |        |   remains illuminated - renew the |
           |        |   Emergency Generator  O/HEAT     |
           |        |   Caption Light Module (103).     |
           |         ------------------------------------
           |
I.*******************************************
  *Apply the following master warning (M/W) *
  *test procedures to each caption CSD 1,   *
  *CSD 2, CSD 3, and CSD 4, in turn:-       *
  *(a) Press the face of the caption and    *
  *    check that the caption is illumina-  *
  *    ted, the amber ELEC caption on the   *
  *    M/W display panel is illuminated and *
  *    the audio warning (single-stroke     *
  *    gong) sounds.                        *
```

```
*(b) Release the face of the caption and  *
*    check that the caption is            *
*    extinguished and the amber ELEC      *
*    caption on the M/W display panel is  *
*    extinguished.  IF-                  *
*******************************************
           |      |
           |      |      ---------------------------------
           |      |     |1. When a CSD caption is pressed, |
          OK    NOT OK--|   the caption is not illuminated,|
           |            |   the M/W amber ELEC caption is  |
           |            |   not illuminated and no         |
           |            |   audio warning is given - check |
           |            |   for 28 V d.c. output at the    |
           |            |   appropriate supply CB: CB(187) |
           |            |   (CSD2); CB(188) (CSD1); CB(189)|
           |            |   (CSD4); CB(190) (CSD3).  If    |
           |            |   absent, renew Circuit Breaker  |
           |            |   (187), (188),  (189) or (190). |
           |            |   If present, *renew CSD Caption |
           |            |   Light Module (195), (196),     |
           |            |   (197) or (198).                |
           |            |2. When a CSD caption is pressed, |
           |            |   the caption is illuminated, but|
           |            |   the M/W amber ELEC caption is  |
           |            |   not illuminated and/or no      |
           |            |   audio warning is given - refer |
           |            |   to Trouble Shooting of the     |
           |            |   Master Warning System (Ref.    |
           |            |   33-15-00) and/or the Audio     |
           |            |   Warning System (Ref. 31-23-00).|
           |            |3. When released after            |
           |            |   satisfactory operation, a CSD  |
           |            |   caption remains illuminated -  |
           |            |   renew CSD Caption Light Module |
           |            |   (195), (196), (197) or (198).  |
           |             ---------------------------------
           |
J.********************************************
  *Set both battery control switches to "BATT*
  *OFF". Remove the safety clips and reset   *
  *CBs (181) and (182), then ensure that the *
  *generator (GEN) failure captions GEN 1,   *
  *GEN 2, GEN 3 and GEN 4 are illuminated.   *
  *IF -                                      *
  ********************************************
           |      |
```

OK — NOT OK:

1. A GEN failure caption remains extinguished - Chart 122.
2. GEN failure captions GEN 1 and GEN 2 or GEN 3 and GEN 4 remain extinguished - check for 28 V d.c. output at CB (181) or (182); renew CB or rectify O/C as necessary.

K. Set the ground power control switch on the electrical generating control panel to "TRIP" and release it. Reconnect the IDG oil low pressure switch connectors disconnected in Preparation paragraph 2.K. i.e., 1X1-C, 2X1-C, 3X1-C abd 4X1-C. Tighten and wire-lock each connector (Ref. Wiring Diagram Manual, 20-42-48). Set the ground power control switch to "CLOSE" and release it and check that the CSD failure captions CSD 1, CSD 2, CSD 3, and CSD 4 are illuminated. IF -

OK — NOT OK:

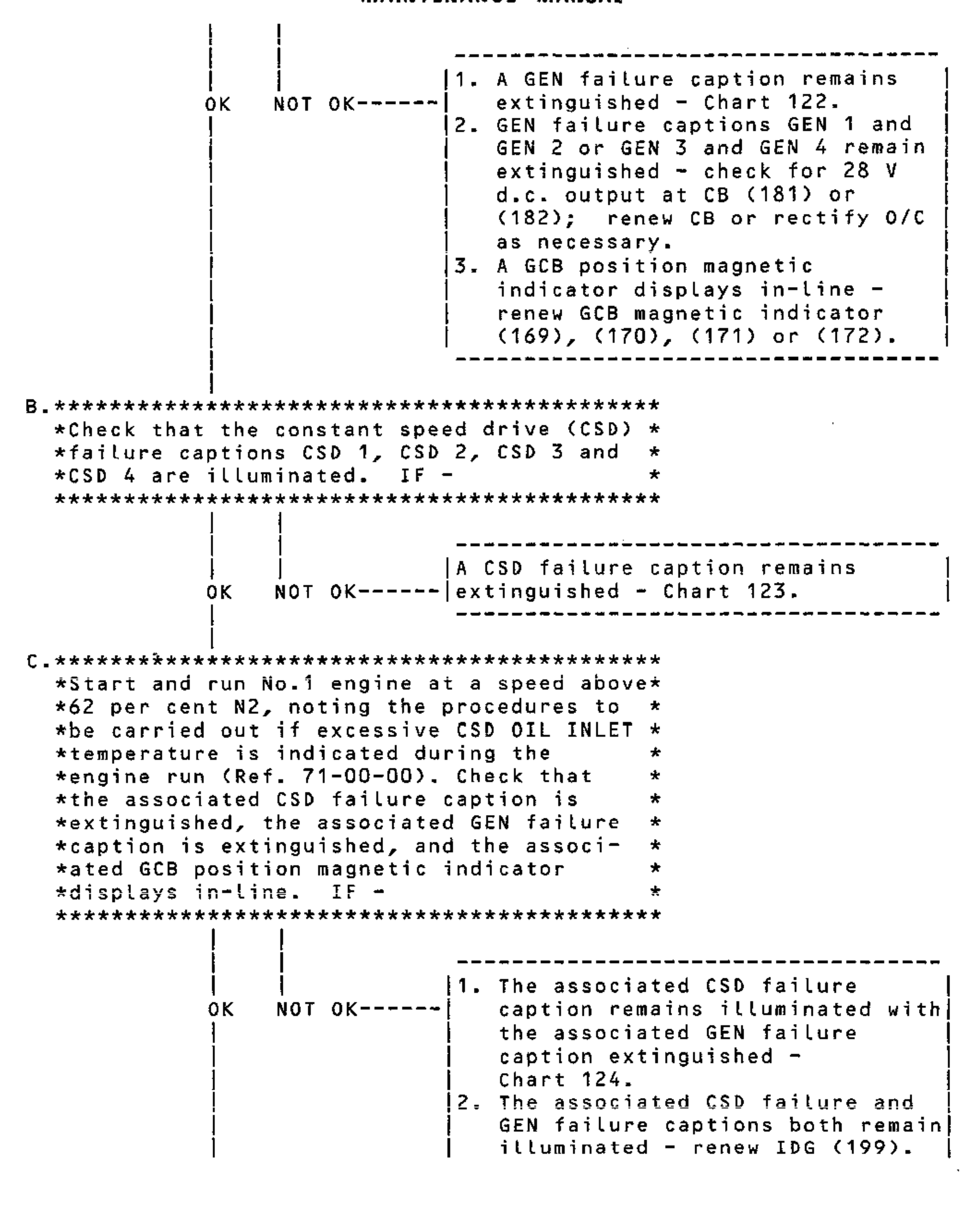
A CSD failure caption remains extinguished - Chart 123.

L. Close the engine bay doors (Ref. 71-00-00).

13. <u>Trouble Shooting - AC Generation - Using Main Engines</u>

A. Prepare to trouble shoot (Ref. para.2.L.). Check that the generator (GEN) failure captions GEN 1, GEN 2, GEN 3 and GEN 4 are illuminated and that Nos.1, 2, 3 and 4 generator circuit breaker (GCB) position magnetic indicators display cross-line. IF -

<u>NOTE</u>: Before renewal of components (*), check the associated wiring for continuity.



OK — continue.

NOT OK:

1. A GEN failure caption remains extinguished - Chart 122.
2. GEN failure captions GEN 1 and GEN 2 or GEN 3 and GEN 4 remain extinguished - check for 28 V d.c. output at CB (181) or (182); renew CB or rectify O/C as necessary.
3. A GCB position magnetic indicator displays in-line - renew GCB magnetic indicator (169), (170), (171) or (172).

B. Check that the constant speed drive (CSD) failure captions CSD 1, CSD 2, CSD 3 and CSD 4 are illuminated. IF -

OK — continue.

NOT OK: A CSD failure caption remains extinguished - Chart 123.

C. Start and run No.1 engine at a speed above 62 per cent N2, noting the procedures to be carried out if excessive CSD OIL INLET temperature is indicated during the engine run (Ref. 71-00-00). Check that the associated CSD failure caption is extinguished, the associated GEN failure caption is extinguished, and the associated GCB position magnetic indicator displays in-line. IF -

OK — continue.

NOT OK:

1. The associated CSD failure caption remains illuminated with the associated GEN failure caption extinguished - Chart 124.
2. The associated CSD failure and GEN failure captions both remain illuminated - renew IDG (199).

3. The associated GEN failure caption remains illuminated with the associated GCB position magnetic indicator displaying cross-line - Chart 125.
4. The associated GEN failure caption remains illuminated with the associated GCB position magnetic indicator displaying in line - disconnect terminal 2 of GEN Caption Light Module (173). If fault is cleared, renew GCB (177). If fault remains, renew GEN Caption Light Module (173).
5. The associated GEN failure caption is extinguished with the associated GCB position magnetic indicator displaying cross-line - check for 28 V d.c. at terminal A of GCB position magnetic indicator. If present, *renew GCB position magnetic indicator (169); if absent, *renew GCB (177).

D. With No.1 engine running at a speed above 62 per cent N2, check that the auto shed breaker (ASB) position magnetic indicator displays in-line. IF -

OK

NOT OK - ASB position magnetic indicator displays cross-line - Chart 126.

```
E.*******************************************
  *Start and run Nos.2, 3 and 4 engines, in  *
  *turn, at a speed above 62 per cent N2,    *
  *noting the procedures to be carried out if*
  *excessive CSD OIL INLET temperature is    *
  *indicated during the engine run           *
  *(Ref. 71-00-00). Check that as each engine*
  *runs up to speed, the associated CSD      *
  *failure caption is extinguished,          *
  *the associated GEN failure caption is     *
  *extinguished, and the associated GCB      *
  *position magnetic indicator displays in-  *
  *line.  If paralleling of a generator      *
  *(closure of the associated GCB) does not  *
  *occur automatically, use the parallel     *
  *assist (P/ASSIST) switch facility as      *
  *described in the Adjustment/Test          *
  *procedure.  IF -                          *
  ********************************************
           |     |
           |     |
           |     |
           OK    NOT OK------|1. A CSD failure caption remains
           |                 |   illuminated with the associated
           |                 |   GEN failure caption extinguished
           |                 |   - Chart 124.
           |                 |2. A CSD failure caption and the
           |                 |   associated GEN failure caption
           |                 |   both remain illuminated - renew
           |                 |   IDG (200), (201) or (202).
           |                 |3. A GEN failure caption remains
           |                 |   illuminated with the associated
           |                 |   GCB position magnetic indicator
           |                 |   displaying cross-line - Chart
           |                 |   127.
           |                 |4. A GEN failure caption remains
           |                 |   illuminated with the associated
           |                 |   GCB position magnetic indicator
           |                 |   displaying in-line - disconnect
           |                 |   terminal 2 of GEN Caption Light
           |                 |   Module (174), (175) or (176). If
           |                 |   fault is cleared, renew GCB
           |                 |   (178), (179) or (180).  If fault
           |                 |   remains, renew GEN Caption Light
           |                 |   Module (174), (175) or (176).
```

5. A GEN failure caption is extinguished with the associated GCB position magnetic indicator displaying cross-line. Check for 28 V d.c. at terminal A of GCB position magnetic indicator. If present, *renew GCB position magnetic indicator (170), (171) or (172); if absent, *renew GCB (178), (179) or (180).

F. *Set the AC FREQ/VOLTS selector switch to "GEN 1", "GEN 2", "GEN 3" and "GEN 4", in turn, and check that the nominal voltage and frequency (approx. 115 V 400 Hz) are displayed on the voltmeter and frequency meter at each switch position. IF -

OK

NOT OK------ Voltage and frequency are not displayed when the associated generator is selected at the AC FREQ/VOLTS selector switch - Chart 128.

G. *Check that the paralleling of Nos.1, 2, 3 and 4 main generation channels is established, by observing that Nos.1, 2, 3 and 4 bus-tie breaker (BTB) position magnetic indicators display in-line with Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions extinguished. IF -

OK

NOT OK------ A BTB position magnetic indicator displays cross-line - Chart 129.

```
               |
H.********************************************
  *Note the reading in kilowatts indicated on*
  *Nos.1, 2, 3 and 4 KW/KVAR meters.  Check  *
  *that any difference in load sharing, so   *
  *indicated, does not exceed 6 kW.  Press   *
  *the PUSH FOR KVAR push-switch and note the*
  *reading on Nos.1, 2 3 and 4 KW/KVAR       *
  *meters.  Check that any difference in load*
  *sharing, so indicated, does not exceed    *
  *4 kVAR.  IF -                             *
  ********************************************
               |    |
               |    |     -----------------------------------
               |    |    |1. A KW/KVAR meter gives zero KW   |
               OK   NOT OK------|   indication (PUSH FOR KVAR switch|
               |         |   released) - Chart 130.          |
               |         |2. Nos.1 and 2 or 3 and 4 KW/KVAR  |
               |         |   meters give zero KVAR           |
               |         |   indication, i.e., when PUSH FOR |
               |         |   KVAR switch is operated - *renew|
               |         |   associated KW/KVAR C/O Relay    |
               |         |   (224) or (225).                 |
               |         |3. A KW/KVAR meter gives zero KVAR |
               |         |   indication, i.e., when PUSH FOR |
               |         |   KVAR switch is operated -       |
               |         |   Chart 131.                      |
               |         |4. All KW/KVAR meters continue to  |
               |         |   give KW indication when PUSH FOR|
               |         |   KVAR switch is operated - *renew|
               |         |   PUSH FOR KVAR switch (226).     |
               |         |5. A KW/KVAR meter continues to    |
               |         |   give KW indication when PUSH FOR|
               |         |   KVAR switch is operated - renew |
               |         |   the associated C/O relay, i.e., |
               |         |   *renew Nos.1 & 2 Meters KW/KVAR |
               |         |   C/O Relay (224) or *renew Nos.3 |
               |         |   & 4 Meters KW/KVAR C/O Relay    |
               |         |   (225).                          |
               |         |6. A KW/KVAR meter indicates a load|
               |         |   sharing difference exceeding    |
               |         |   6 kW - Chart 132.               |
               |         |7. A KW/KVAR meter indicates a load|
               |         |   sharing difference exceeding    |
               |         |   4 kVAR - Chart 133.             |
               |          -----------------------------------
               |
```

```
                  |
I.********************************************
  *Check that the oil temperature of each IDG*
  *is indicated on the INLET and DIFF scales *
  *of the correspondingly-numbered CSD oil   *
  *temperature indicator and that the over-  *
  *heat warning lamp on the front of each    *
  *indicator is not lit.  IF -               *
  *                                          *
  *NOTE:  Under ground running conditions,   *
  *       the oil inlet temperature and      *
  *       differential temperature will be   *
  *       approximately 80 deg C and 15 deg C*
  *       respectively.  These values will   *
  *       vary according to the generator    *
  *       load and ambient temperature.      *
  ********************************************
                  |    |
                  |    |    ----------------------------------
                  |    |   |The temperature indicated on the |
                  OK   NOT OK------|INLET or DIFF scale of a CSD oil |
                  |        |temperature indicator is         |
                  |        |abnormally high or abnormally low|
                  |        |or the overheat warning lamp on  |
                  |        |the front of the indicator is lit|
                  |        |- record the fault indication,   |
                  |        |then check the oil temperature   |
                  |        |indication circuits (Ref. 24-11-00|
                  |        |Adjustment/Test) and trouble     |
                  |        |shoot accordingly.  If no faults |
                  |        |found, retain the record of the  |
                  |        |fault indication and refer to    |
                  |        |Chart 134.                       |
                  |         ----------------------------------
                  |
```

J. Apply the following master warning (M/W) test procedures to each failure caption, GEN 1, GEN 2, GEN 3 and GEN 4, in turn:-

(a) Press the face of the caption and check that the caption is illuminated, the amber ELEC caption on the M/W display panel is illuminated and the audio warning (single-stroke gong) sounds.

(b) Release the face of the caption and check that the caption is extinguished and the amber ELEC caption on the M/W display panel is extinguished. IF -

OK

NOT OK:

1. When a GEN failure caption is pressed, the caption is not illuminated, the M/W amber ELEC caption is not illuminated and no audio warning is given - *renew GEN Caption Light Module (173), (174), (175) or (176).
2. When a GEN failure caption is pressed, the caption is illuminated, but the M/W amber ELEC caption is not illuminated and/or no audio warning is given - refer to Trouble Shooting of the Master Warning System (Ref. 33-15-00) and/or the Audio Warning System (Ref. 31-23-00).
3. When released after satisfactory operation, a GEN failure caption remains illuminated - renew the appropriate (GEN) Caption Light Module (173), (174), (175) or (176).

Before SB24-023

```
          |
K.********************************************
  *Set the emergency generator mode switch to*
  *"GRD BY-PASS".  Set Nos.2 and 3 essential/*
  *main (NORM/EMERG) control switches to     *
  *"EMERG".  Check that the emergency        *
  *generator starts running, i.e., the       *
  *SELECTED caption is illuminated and the   *
  *FAIL caption is not illuminated.  Check   *
  *also that Nos.2 and 3 AC ESS BUS captions *
  *are extinguished, indicating that the     *
  *emergency generator output is connected to*
  *the associated busbars via the 'A' and 'B'*
  *system emergency busbars, and that the    *
  *emergency generator voltage and frequency *
  *are correct (approx. 115 V 400 Hz) and not*
  *fluctuating.  IF -                        *
  ********************************************
           |    |
           |    |       ------------------------------------
           |    |      |1. With the emergency generator     |
           OK   NOT OK-|   SELECTED caption illuminated,    |
           |           |   the FAIL caption is also         |
           |           |   illuminated - press-to-test the  |
           |           |   emergency generator FAIL caption |
           |           |   and check that fault is cleared. |
           |           |   If YES, check the fault indica-  |
           |           |   tion on the emergency Generator  |
           |           |   Control and Protection Unit      |
           |           |   (CPU) (88).                      |
           |           |NOTE:  With the emergency generator |
           |           |       running on test after        |
           |           |       clearance of an overvoltage  |
           |           |       (O/V) or differential        |
           |           |       protection (DP) fault, the   |
           |           |       FAIL caption must be pressed |
           |           |       -to-test (CPU reset) to      |
           |           |       reinstate the generator      |
           |           |       output, and the fault indi-  |
           |           |       cator on the CPU (88) must   |
           |           |       be reset by insertion of a   |
           |           |       suitable probe through the   |
           |           |       CPU front panel to activate  |
           |           |       the appropriate reset micro- |
           |           |       switch, SW1 (O/V) or SW5     |
           |           |       (DP).                        |
           |           |   If fault is not cleared, i.e.,   |
```

FAIL caption remains illuminated, apply an Emergency Generation Functional Test Using Hydraulic Ground Power and trouble shoot accordingly (Ref. para.11.).

2. No.2 or No.3 AC ESS BUS is illuminated with all other indications correct - *renew Essential/Main Change-over Contactor (55) or (56).
3. No.3 AC ESS BUS caption illuminated with emergency generator SELECTED caption illuminated and FAIL caption extinguished - *renew ASB (100).
4. Emergency generator voltage and/or frequency indications are fluctuating - renew Emergency Generator and Drive Unit (162).

L. With Nos.2 and 3 essential/main (NORM/EMERG) control switches set to "EMERG", check that the 'A' and 'B' system 26 V a.c. main busbars are shed, by observing that the power supply failure warning flag is visible on the blue system quantity indicator and the yellow system quantity indicator on the hydraulic management panel. IF -

OK

NOT OK:

1. 26 V a.c. 'A' main busbar remains 'live', i.e., supply failure warning flag is not visible on hydraulic system quantity indicator - renew Load Shed Contactor (107).
2. 26 V a.c. 'B' main busbar remains 'live', i.e., supply failure warning flag is not visible on yellow hydraulic system quantity indicator - renew Load Shed Contactor (108)

```
                  |
M.*********************************************
   *Return Nos.3 and 4 essential/main (NORM/  *
   *EMERG) control switches to "NORM"; check  *
   *that the emergency generator SELECTED     *
   *caption is extinguished and the emergency *
   *generator ceases running.  IF -           *
   *********************************************
                  |    |
                  |    |       -----------------------------------
                  |    |      |Emergency generator SELECTED       |
                  OK   NOT OK-|caption is extinguished but emerg- |
                  |           |ency generator continues to run -  |
                  |           |renew Hydraulic Selector Valve     |
                  |           |(152).                             |
                  |            -----------------------------------
                  |
N.*********************************************
   *Shut down No.1 engine (Ref. 71-00-00) and *
   *check that when the engine speed falls    *
   *below 58 per cent N2, the emergency       *
   *generator does not commence running, i.e.,*
   *the SELECTED caption is not illuminated.  *
   *IF -                                      *
   *********************************************
                  |    |
                  |    |       -----------------------------------
                  |    |      |The emergency generator SELECTED   |
                  OK   NOT OK-|caption is illuminated - Chart 135.|
                  |            -----------------------------------
                  |
O.*********************************************
   *Shut down No.2 engine (Ref. 71-00-00) and *
   *check that when the engine speed falls    *
   *below 58 per cent N2, the ASB position    *
   *magnetic indicator changes from in-line to*
   *cross-line and the emergency generator    *
   *SELECTED caption is illuminated (the      *
   *generator starts running), followed by    *
   *illumination of the FAIL caption after a  *
   *short period. (The starting and subsequent*
   *run-down of the emergency generator, as   *
   *indicated, is explained in the Adjustment/*
   *Test).  IF -                              *
   *********************************************
                  |    |
```

```
          |       |
          |       |      ----------------------------------
          |       |     |1. The ASB position magnetic       |
          OK    NOT OK--|   indicator remains in-line and   |
          |             |   the emergency generator SELECTED|
          |             |   caption is not illuminated -    |
          |             |   renew Engine Speed Unit (95).   |
          |             |2. The ASB position magnetic indi- |
          |             |   cator changes from in-line to   |
          |             |   cross-line but the emergency    |
          |             |   generator SELECTED caption is   |
          |             |   not illuminated - *renew Engine |
          |             |   Speed Unit (95).                |
          |             |3. The emergency generator SELECTED|
          |             |   caption is illuminated, but the |
          |             |   ASB position magnetic indicator |
          |             |   remains in-line - renew Engine  |
          |             |   Speed Unit (95).                |
          |              ----------------------------------
          |
P.*********************************************
  *Set the emergency generator mode switch to*
  *"AUTO".  Set the emergency generator      *
  *isolate switch to "ISOL" and then back to *
  *"NORM" to extinguish the emergency        *
  *generator SELECTED and FAIL captions. Shut*
  *down Nos.3 and 4 engines (Ref. 71-00-00). *
  *Set BATT A and BATT B control switches to *
  *"BATT OFF".                               *
  *********************************************
```

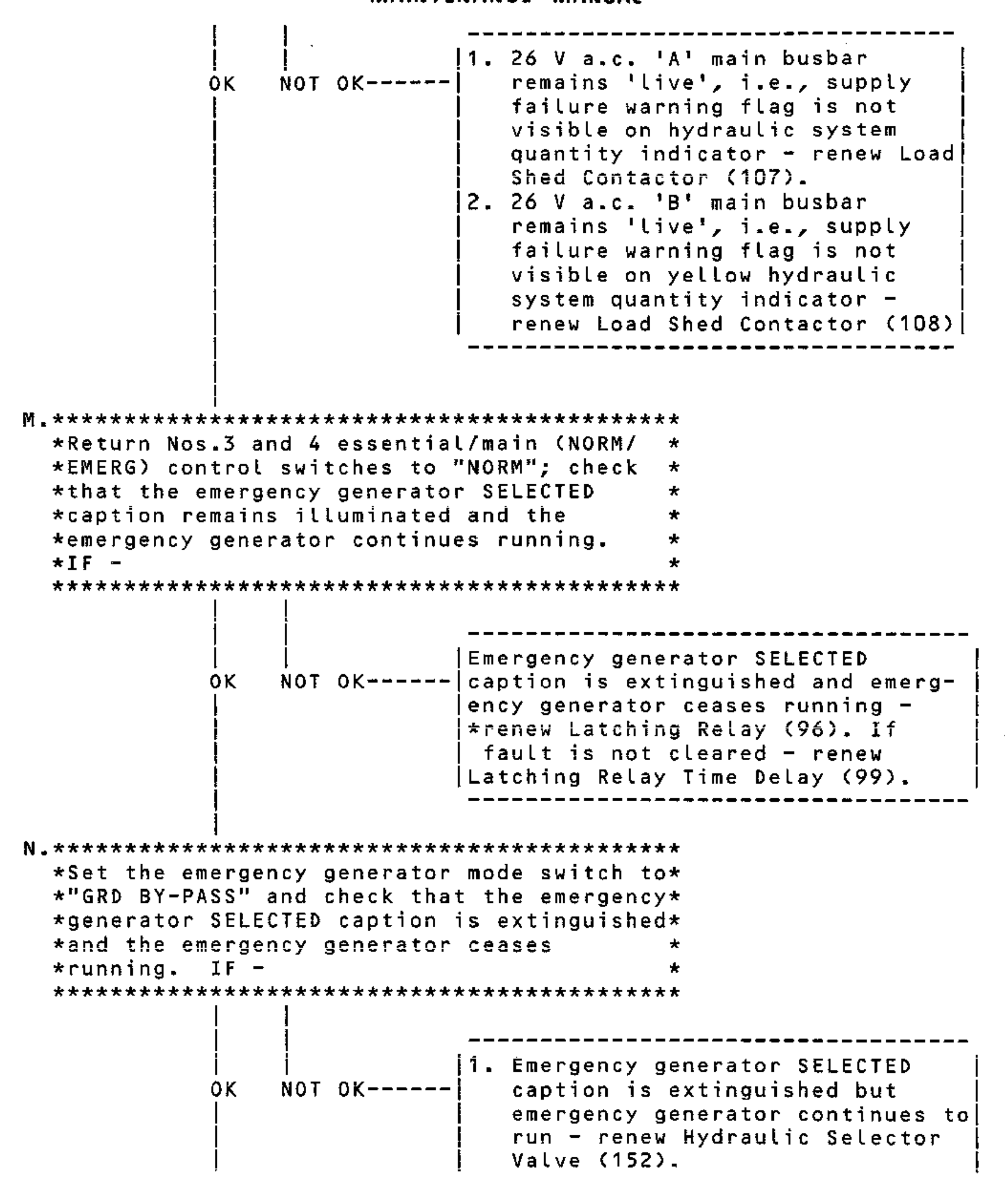
```
K.*********************************************
  *Check that the emergency generator mode    *
  *switch is at AUTO.  Set Nos.2 and 3        *
  *essential/main (NORM/EMERG)control         *
  *switches to "EMERG".  Check that the       *
  *emergency generator starts running, i.e., *
  *the SELECTED caption is illuminated and    *
  *the FAIL caption is not illuminated. Check*
  *also that Nos.2 and 3 AC ESS BUS captions *
  *are extinguished, indicating that the      *
  *emergency generator output is connected to*
  *the associated busbars via the 'A' and 'B'*
  *system emergency busbars, and that the     *
  *emergency generator voltage and frequency *
  *are correct (approx. 115 V 400 Hz) and not*
  *fluctuating.  IF -                         *
  *********************************************
            |    |
            |    |           ------------------------------------
            |    |          |1. SELECTED caption not illuminated|
           OK   NOT OK------|   i.e., emergency generator is not|
            |               |   started - * renew Override Relay|
            |               |   (232); if fault is not cleared, |
            |               |   renew Emergency Generator Mode  |
            |               |   Switch (92).                    |
            |               |2. With the emergency generator    |
            |               |   SELECTED caption illuminated    |
            |               |   the FAIL caption is also        |
            |               |   illuminated - press-to-test the |
            |               |   emergency generator FAIL caption|
            |               |   and check that fault is cleared.|
            |               |   If YES, check the fault indica- |
            |               |   tion on the Emergency Generator |
            |               |   Control and Protection Unit     |
            |               |   (CPU) (88).                     |
            |               |NOTE:  With the emergency generator|
```

running on test after clearance of an overvoltage (O/V) or differential protection (DP) fault, the FAIL caption must be pressed -to-test (CPU reset) to reinstate the generator output, and the fault indicator on the CPU (88) must be reset by insertion of a suitable probe through the CPU front panel to activate the appropriate reset microswitch, SW1 (O/V) or SW5 (DP).

If fault is not cleared, i.e., FAIL caption remains illuminated, apply an Emergency Generation Functional Test Using Hydraulic Ground Power and trouble shoot accordingly (Ref. para.11.).

3. No.2 or No.3 AC ESS BUS is illuminated with all other indications correct - *renew Essential/Main Change-over Contactor (55) or (56).
4. No.3 AC ESS BUS caption illuminated with emergency generator SELECTED caption illuminated and FAIL caption extinguished - *renew ASB (100).
5. Emergency generator voltage and/or frequency indications are fluctuating - renew Emergency Generator and Drive Unit (162).

L. ***
*With Nos.2 and 3 essential/main (NORM/ *
*EMERG) control switches set to "EMERG", *
*check that the 'A' and 'B' system 26 V *
*a.c. main busbars are shed, by observing *
*that the power supply failure warning *
*flag is visible on the blue system *
*quantity indicator and the yellow system *
*quantity indicator on the hydraulic *
*management panel. IF - *
****


OK
NOT OK
1. 26 V a.c. 'A' main busbar remains 'live', i.e., supply failure warning flag is not visible on hydraulic system quantity indicator - renew Load Shed Contactor (107).
2. 26 V a.c. 'B' main busbar remains 'live', i.e., supply failure warning flag is not visible on yellow hydraulic system quantity indicator - renew Load Shed Contactor (108)
M. Return Nos.3 and 4 essential/main (NORM/EMERG) control switches to "NORM"; check that the emergency generator SELECTED caption remains illuminated and the emergency generator continues running. IF -
OK
NOT OK
Emergency generator SELECTED caption is extinguished and emergency generator ceases running - *renew Latching Relay (96). If fault is not cleared - renew Latching Relay Time Delay (99).
N. Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator SELECTED caption is extinguished and the emergency generator ceases running. IF -
OK
NOT OK
1. Emergency generator SELECTED caption is extinguished but emergency generator continues to run - renew Hydraulic Selector Valve (152).

2. Emergency generator SELECTED caption remains illuminated and emergency generator continues to run - renew Emergency Generator Mode Switch (92).

O. Shut down No.1 engine (Ref. 71-00-00) and check that when the engine speed falls below 58 per cent N2, the emergency generator does not commence running, i.e., the SELECTED caption is not illuminated.
IF -

OK

NOT OK ------ The emergency generator SELECTED caption is illuminated - Chart 135.

P. Shut down No.2 engine (Ref. 71-00-00) and check that when the engine speed falls below 58 per cent N2, the ASB position magnetic indicator changes from in-line to cross-line and the emergency generator SELECTED caption is illuminated (the generator starts running), followed by illumination of the FAIL caption after a short period. (The starting and subsequent run-down of the emergency generator, as indicated, is explained in the Adjustment/Test). IF -

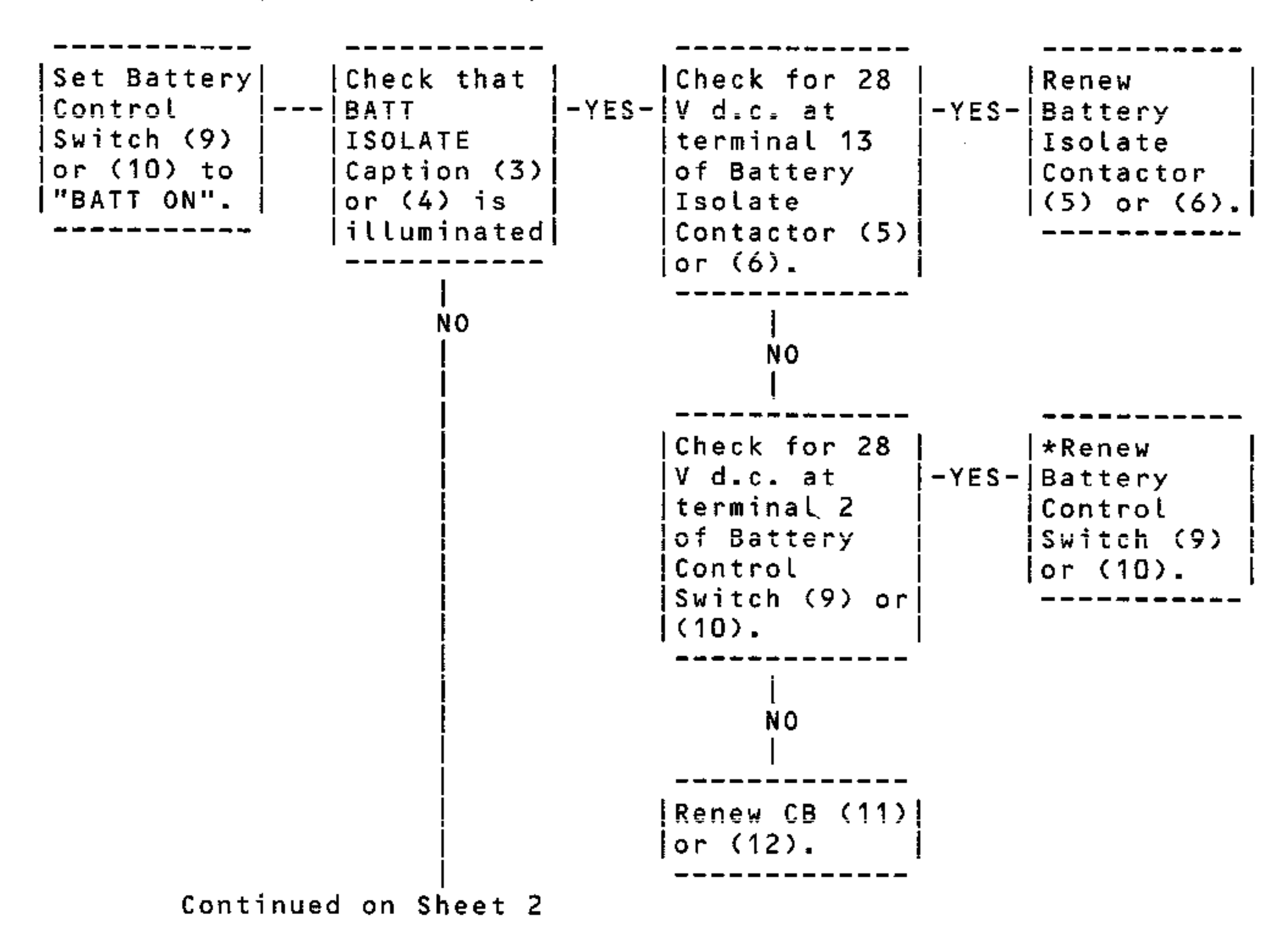
```
       |      |
       |      |             -------------------------------------
       |      |            |1. The ASB position magnetic          |
       OK     NOT OK-------|   indicator remains in-line and      |
       |                   |   the emergency generator SELECTED   |
       |                   |   caption is not illuminated -       |
       |                   |   renew Engine Speed Unit (95).      |
       |                   |2. The ASB position magnetic indi-    |
       |                   |   cator changes from in-line to      |
       |                   |   cross-line but the emergency       |
       |                   |   generator SELECTED caption is      |
       |                   |   not illuminated - *renew Engine    |
       |                   |   Speed Unit (95).                   |
       |                   |3. The emergency generator SELECTED   |
       |                   |   caption is illuminated, but the    |
       |                   |   ASB position magnetic indicator    |
       |                   |   remains in-line - renew Engine     |
       |                   |   Speed Unit (95).                   |
       |                    -------------------------------------
       |
Q.********************************************
  *Set the emergency generator mode switch to*
  *"AUTO".  Set the emergency generator      *
  *isolate switch to "ISOL" and then back to *
  *"NORM" to extinguish the emergency        *
  *generator SELECTED and FAIL captions. Shut*
  *down Nos.3 and 4 engines (Ref. 71-00-00). *
  *Set BATT A and BATT B control switches to *
  *"OFF".                                    *
  ********************************************
```

R **ON A/C 001-006,

```
********************************
*BATTERY ISOLATE MAGNETIC      *
*INDICATOR REMAINS CROSS-LINE  *
*WHEN BATTERY IS SWITCHED ON.  *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.



Continued on Sheet 2

Chart 101 (Sheet 1 of 2)

Continued from Sheet 1

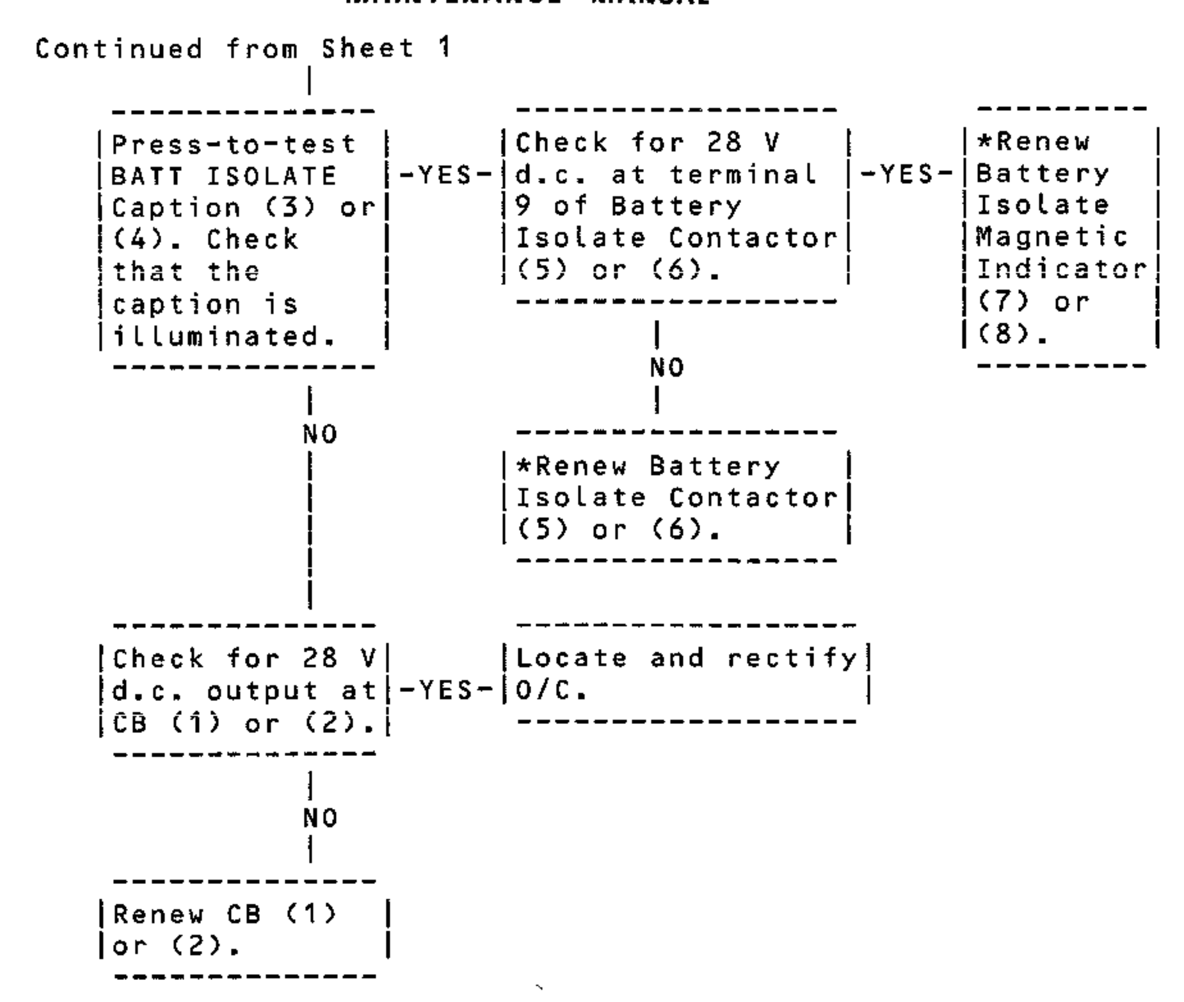


Chart 101 (Sheet 2 of 2)

```
*******************************
*EITHER (A OR B) ESSENTIAL/   *
*MAIN SPLIT MAGNETIC INDICATOR*
*REMAINS IN-LINE WITH         *
*ASSOCIATED BATTERY CONTROL   *
*SWITCH SET TO 'ESS/MAIN      *
*SPLIT'.                      *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-

```
 -----------     ------------     ------------     -----------
|Set Battery|   |Trip indi-  |   |Reset CB    |   |Renew      |
|Control    |---|cator supply|-YES-|(228). Trip |-YES-|Battery    |
|Switch (9) |   |CB (228).   |   |CB (229)    |   |Control    |
|or (10) to |   |Does        |   |('A' system)|   |Switch     |
|"ESS/MAIN  |   |magnetic    |   |or (230)    |   |(9) or     |
|SPLIT".    |   |indicator   |   |('B'        |   |(10).      |
 -----------    |change to   |   |system).Does|    -----------
                |cross-line? |   |magnetic    |
                 ------------    |indicator   |
                      |          |change to   |
                      NO         |cross-line? |
                      |           ------------
                 --------------        |
                |Renew Magnetic|       NO
                |Indicator (78)|       |
                |or (79). Reset|   ----------------
                |CB (228).     |  |Renew associated|
                 --------------   |A or B system   |
                                  |Essential/Main  |
                                  |Split Contactor |
                                  |(122) or (123). |
                                   ----------------
```

Chart 102

```
********************************
*ONE 'AC MAIN BUS' CAPTION     *
*REMAINS EXTINGUISHED WHEN SSB*
*CONTROL SWITCH IS SET TO      *
*'OPEN'.                       *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

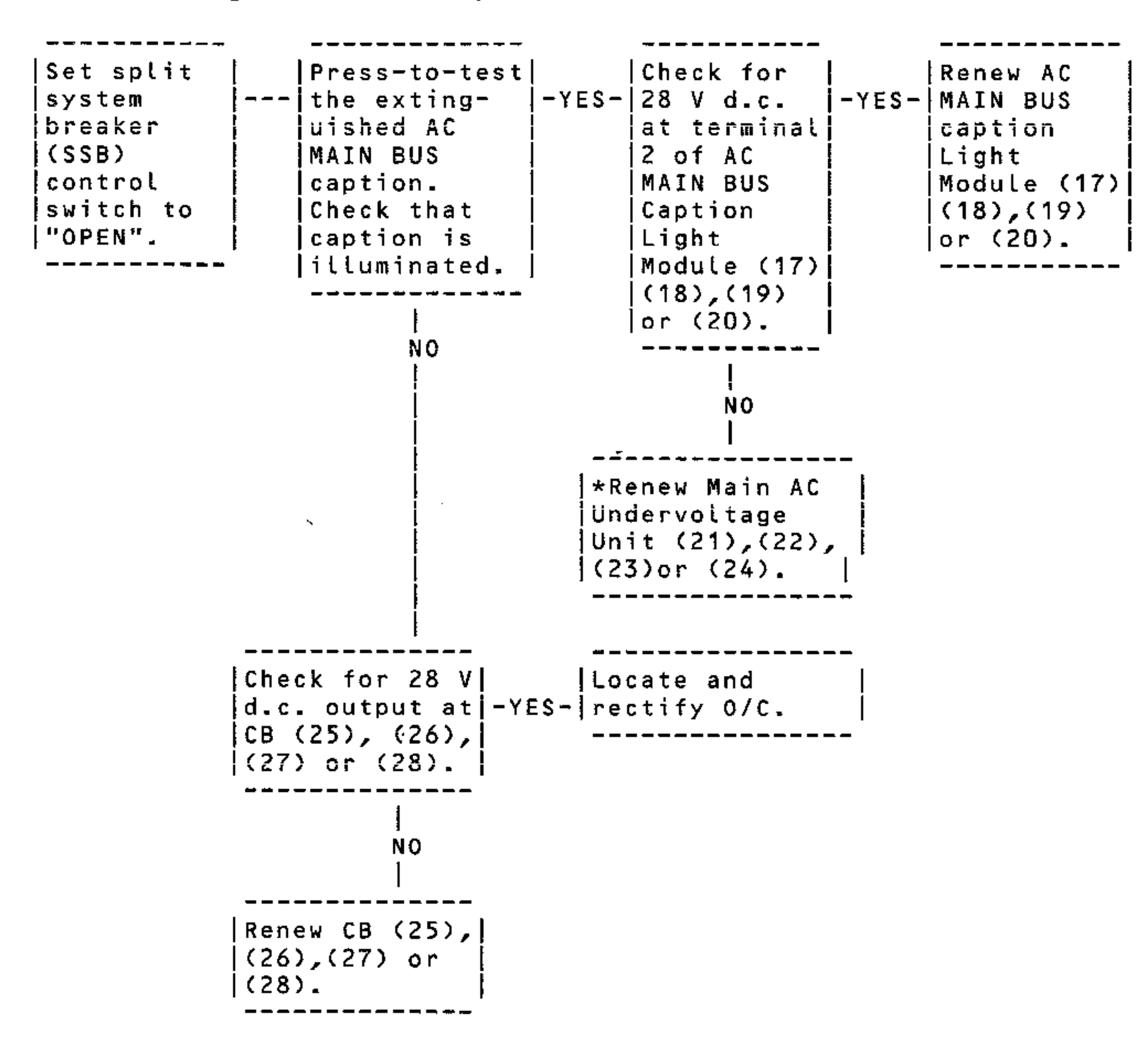


Chart 103

ESSEBTIAL/MAIN ISOLATE MAGNETIC INDICATOR REMAINS IN-LINE WITH ASSOCIATED BTB CONTROL SWITCH SET TO 'TRIP'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

- Set BTB control switch to "TRIP".
- Check for 28 V d.c. at terminal 11 of Essential/Main Change-over Contactor (54),(55), (56) or (57).
  - NO: Renew Essential/ Main Isolate Magnetic Indicator (58),(59), (60) or (61).
  - YES: Check for 28 V d.c. at terminal X1 of Essential/ Main Change-over Contactor (54),(55), (56) or (57).
    - NO: Renew Essential/ Main Isolate Change-over Contactor (54),(55), (56) or (57).
    - YES: Locate and rectify stray positive supply at terminal X1.

Chart 104

```
******************************
*ONE 'AC ESS BUS' CAPTION    *
*REMAINS EXTINGUISHED WITH   *
*ASSOCIATED BTB CONTROL      *
*SWITCH SET TO 'TRIP'.       *
******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

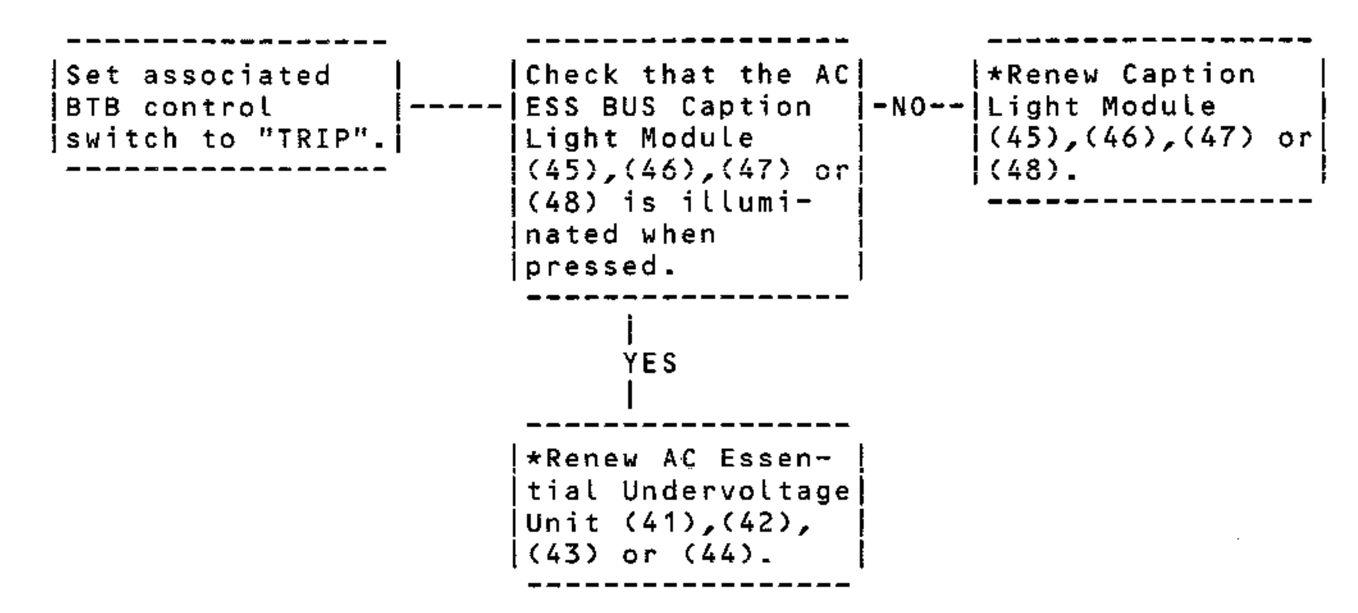


Chart 105

```
********************************
*TRU AMMETER INDICATES LOAD    *
*WITH 'DC MAIN BUS' CAPTION    *
*EXTINGUISHED AND 'A' AND 'B'  *
*ESSENTIAL/MAIN SPLIT MAGNETIC *
*INDICATORS IN-LINE AND ALL    *
*TRU CONTROL SWITCHES AT       *
*'ISOL'.                       *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 ----------------         ----------------          ----------------
|Set all TRU     |       |Check that the  |        |Renew TRU Control|
|control switches|-------|potential at    |--NO-|Switch (68),(69),|
|to "ISOL".      |       |terminal 2 of TRU|       |(70) or (71).    |
 ----------------        |Control Switch  |         ----------------
                         |(68),(69),(70) or|
                         |(71) is at 115 V |
                         |approx.          |
                          ----------------
                                 |
                                YES
                                 |
                          ----------------
                         |Renew TRU Isolate|
                         |Contactor (72),  |
                         |(73),(74) or     |
                         |(75).            |
                          ----------------
```

Chart 106

```
*******************************
*'DC MAIN BUS' CAPTION REMAINS*
*EXTINGUISHED WITH ALL TRUs   *
*ISOLATED.                    *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------------      -----------------        -----------------
|Set all TRU      |    |Check for 28 V   |      |Renew DC MAIN BUS|
|control switches |----|d.c. at terminal |-YES-|Caption Light    |
|to "ISOL".       |    |2 of DC MAIN BUS |      |Module (76).     |
 -----------------     |Caption Light    |       -----------------
                       |Module (76).     |
                        -----------------
                               |
                               NO
                               |
                        -----------------        -----------------
                       |Check for 28 V   |      |Locate and       |
                       |d.c. output at CB|-YES-|rectify O/C.     |
                       |(77).            |       -----------------
                        -----------------
                               |
                               NO
                               |
                        -----------------
                       |Renew CB (77).   |
                        -----------------
```

Chart 107

```
*******************************
*ESSENTIAL/MAIN SPLIT MAGNETIC*
*INDICATOR REMAINS IN-LINE    *
*WITH ALL TRUs ISOLATED.      *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------------     -----------------           -----------------
|Set all TRU      |   |Check for d.c.   |         |Renew Essential/ |
|control switches |---|supply (battery  |--NO-    |Main Split       |
|to "ISOL".       |   |voltage) at      |         |Magnetic         |
 -----------------    |terminal 3 of the|         |Indicator (78)   |
                      |associated (A or |         |or (79).         |
                      |B system)        |          -----------------
                      |Essential/Main   |
                      |Split Contactor  |
                      |(122) or (123).  |
                       -----------------
                              |
                             YES
                              |
                       -----------------
                      |Renew associated |
                      |(A or B system)  |
                      |Main DC Undervolt|
                      |Unit (124) or    |
                      |(125).           |
                       -----------------
```

Chart 108

'A' or 'B' SYSTEM 'DC ESS BUS' CAPTION REMAINS EXTINGUISHED WITH ASSOCIATED BATTERY CONTROL SWITCH SET TO 'BATT OFF'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

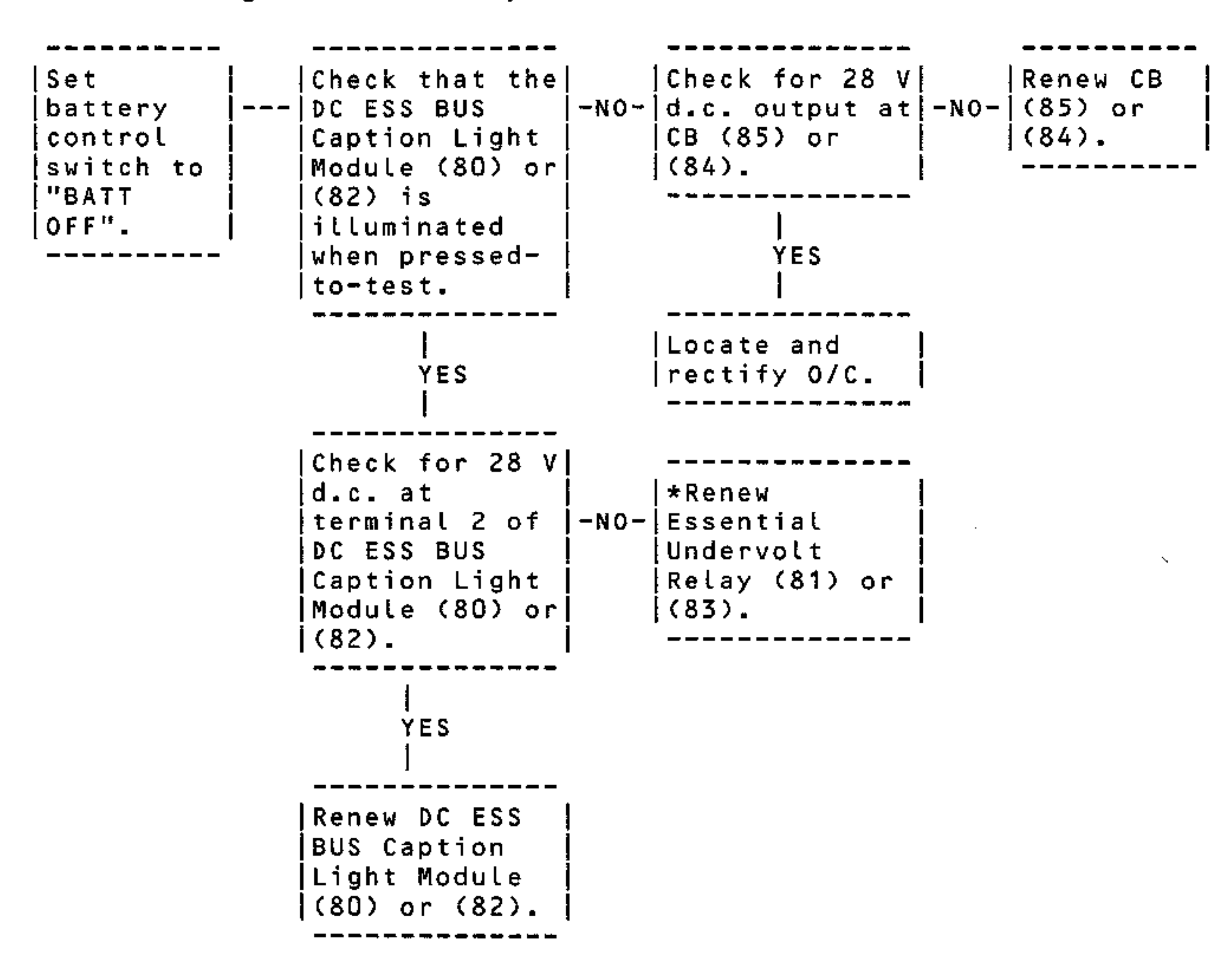


Chart 109

```
*******************************
*'FAIL' CAPTION REMAINS       *
*EXTINGUISHED WITH EMERGENCY  *
*GENERATOR MODE SWITCH SET    *
*TO 'MANUAL'.                 *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------      --------------------------              ----------------
|Set emerg- |    |Check that the FAIL       |            |Renew the FAIL  |
|ency gener-|----|Caption Light Module (87) |-NO-|Caption Light   |
|ator mode  |    |is illuminated when       |            |Module (87).    |
|switch to  |    |pressed-to-test.          |             ----------------
|"MANUAL".  |     --------------------------
 -----------                 |
                            YES
                             |
                  --------------------------              ----------------
                 |Remove the Emergency      |            |Locate and      |
                 |Generator Control and     |-NO-|rectify O/C.    |
                 |Protection Unit (88). Link|            |Remove link and |
                 |pins 16 and 10 together at|            |refit Emergency |
                 |backplate connector       |            |Generator Control|
                 |X201-AA.  Check that the  |            |and Protection  |
                 |FAIL caption is           |            |Unit (88).      |
                 |illuminated.              |             ----------------
                  --------------------------
                             |
                            YES
                             |
                  --------------------------
                 |Remove link and renew     |
                 |Emergency Generator       |
                 |Control and Protection    |
                 |Unit (88).                |
                  --------------------------
```

Chart 110

R **ON A/C 001-006,

'SELECTED' AND 'FAIL' CAPTIONS
*REMAIN EXTINGUISHED WITH *
*EMERGENCY GENERATOR MODE *
*SWITCH SET TO 'MANUAL'. *

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Set emergency generator mode switch to "MANUAL".

Check for 28 V d.c. output at CB (89). -YES- Locate and rectify O/C.

NO

Check for 28 V d.c. at terminal 4 of Emergency Generator Isolate Switch (91). -YES- *Renew CB (89).

NO

Check for 28 V d.c. at terminal 11 of Emergency Generator Mode Switch (92). -YES- *Renew Emergency Generator Isolate Switch (91).

NO

Check for 28 V d.c. output at CB (90). -YES- *Renew Emergency Generator Mode Switch (92).

NO

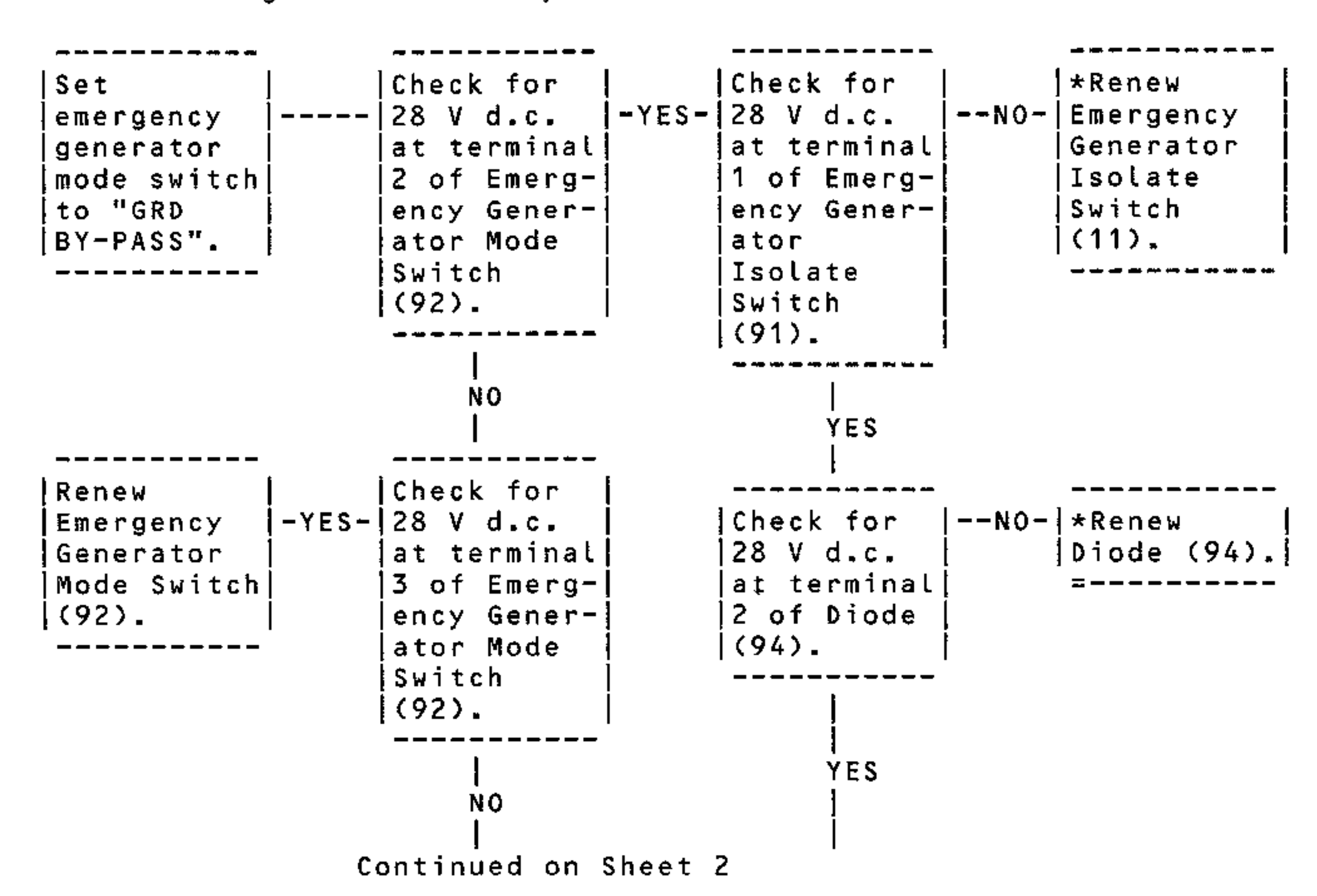
Renew CB (90).

Chart 111

```
*******************************
*'SELECTED' AND 'FAIL'        *
*CAPTIONS ARE EXTINGUISHED    *
*WHEN EMERGENCY GENERATOR MODE*
*SWITCH IS SET TO 'GRD        *
*BY-PASS'.                    *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.



Continued on Sheet 2

Chart 112 (Sheet 1 of 2)

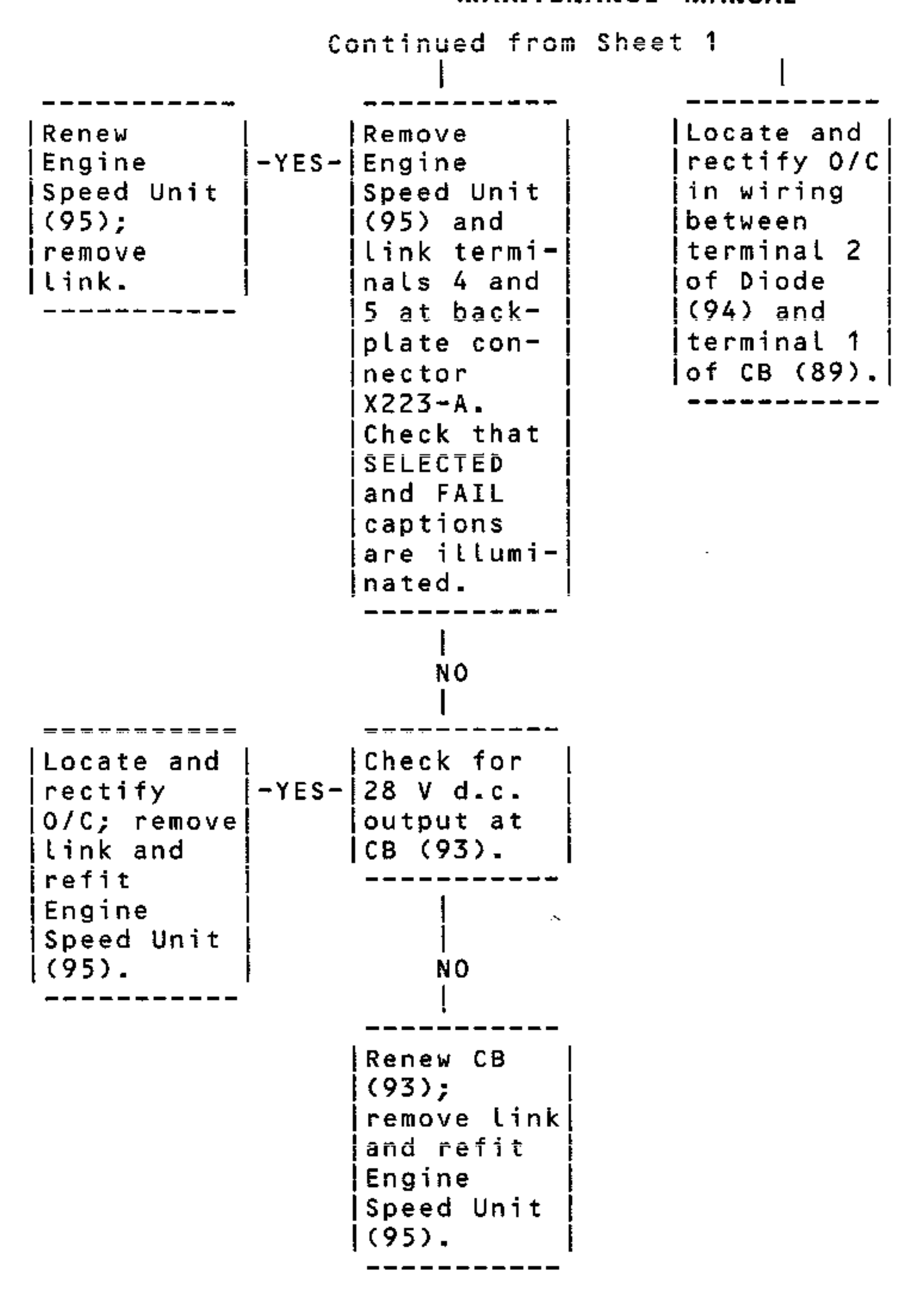


Chart 112 (Sheet 2 of 2)

```
*******************************
*'SELECTED' AND 'FAIL'        *
*CAPTIONS ILLUMINATED WITH THE*
*EMERGENCY GENERATOR MODE     *
*SWITCH SET TO 'AUTO'.        *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

CAUTION: WHEN REMOVING/REPLACING THE WEIGHT SWITCH OPERATED RELAYS CARE MUST BE TAKEN TO ENSURE THAT ALL SERVICES ADVERSELY AFFECTED BY INTERRUPTING THE WEIGHT SWITCH SERVICES ARE PREVIOUSLY ISOLATED (REF. 7-11-00).

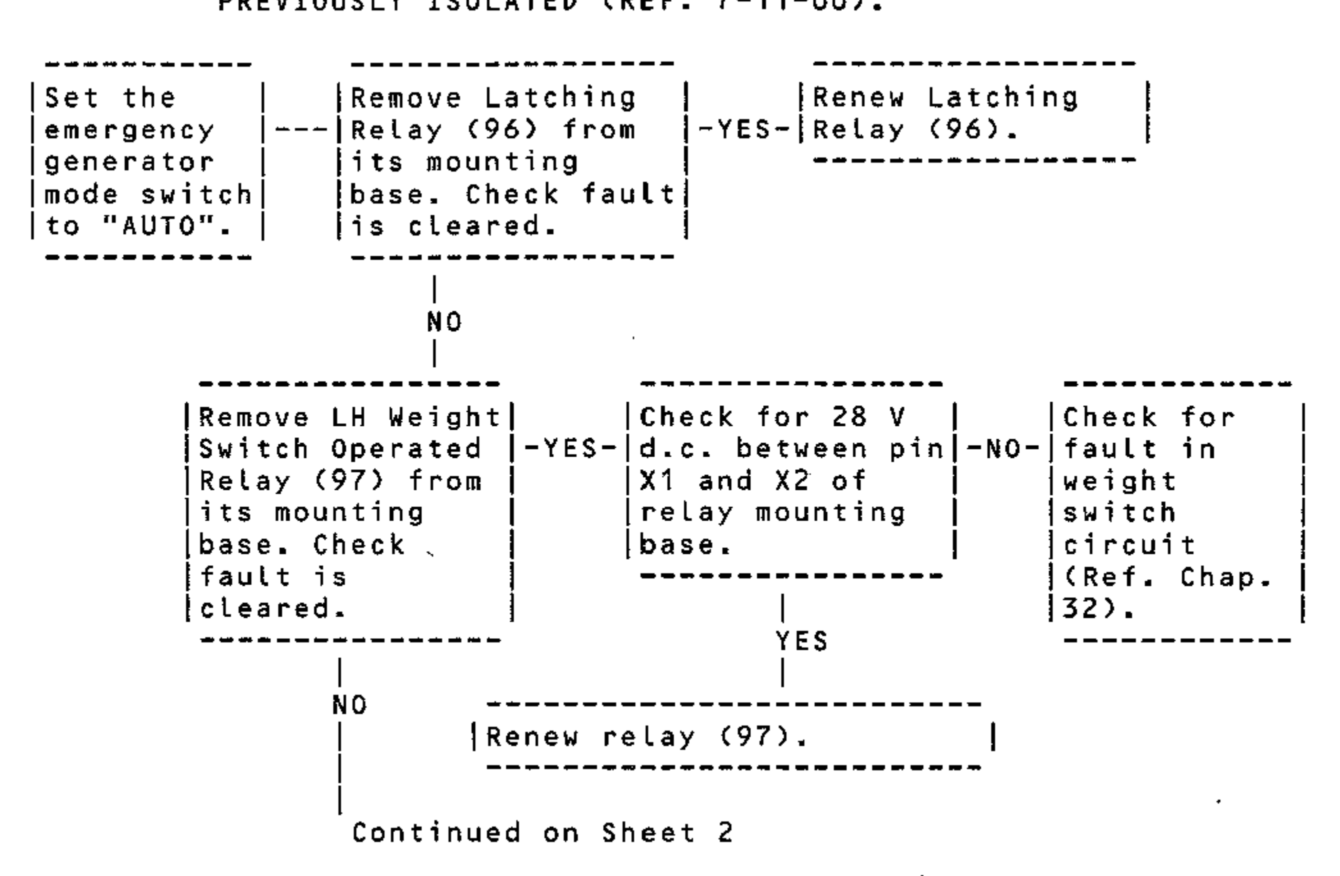


Chart 113 (Sheet 1 of 2)

Continued from Sheet 1

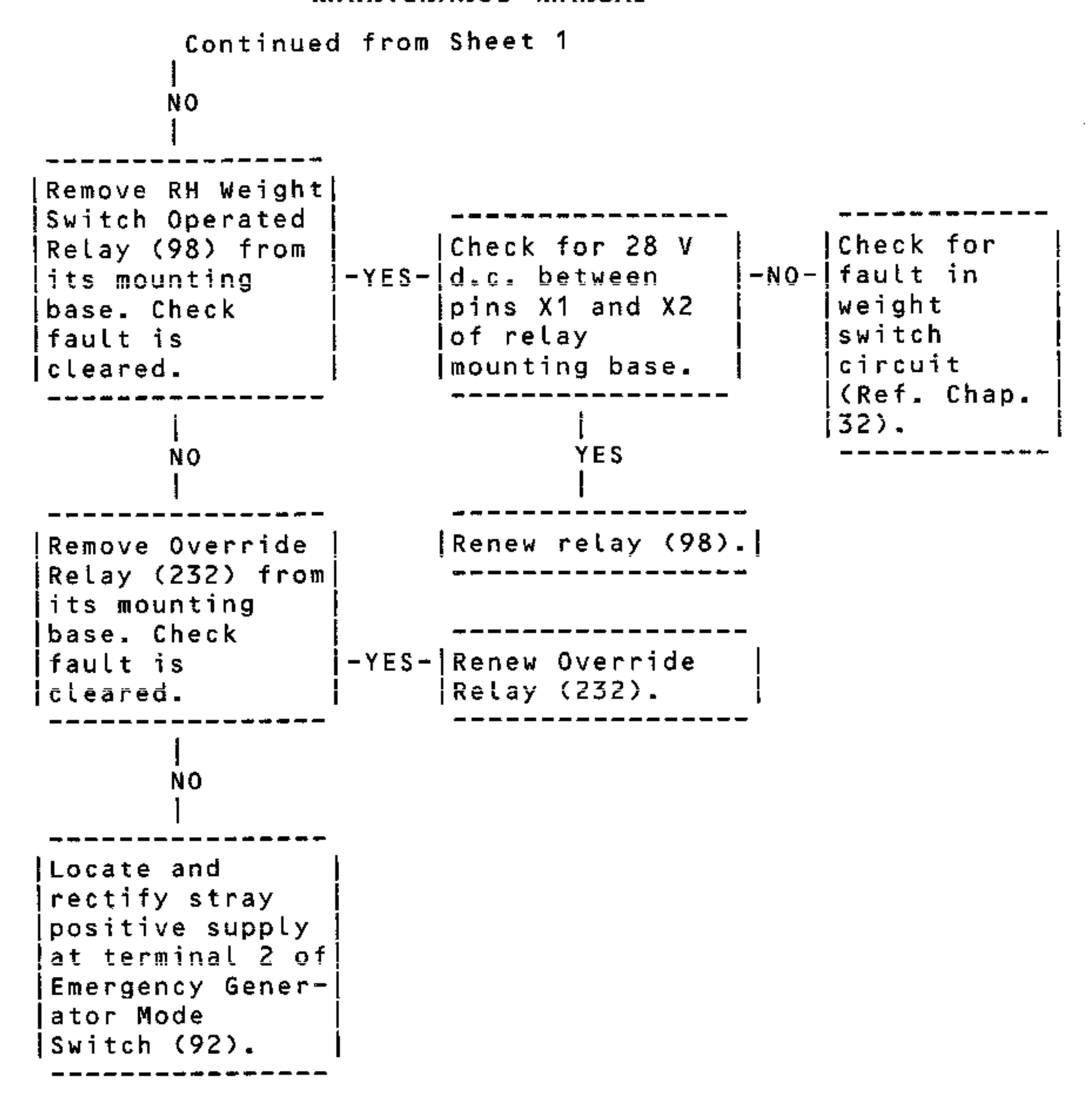


Chart 113 (Sheet 2 of 2)

```
*******************************      -------------------------------
*'A' or 'B' SYSTEM 'BATT      *     |GROUND EQUIPMENT REQUIRED      |
*ISOLATE' CAPTION REMAINS     *     |-------------------------------|
*EXTINGUISHED WITH ASSOCIATED *     |DESCRIPTION          PART NO.  |
*BATTERY CONTROL SWITCH       *     |-------------------------------|
*SET TO 'BATT OFF'.           *     |GROUND POWER SUPPLY   -        |
*******************************     |MULTIMETER            -        |
                                     -------------------------------

 --------      ----------------      -------------      -----------
|Set     |    |Check that      |    |Trip CB (11) |    |Renew      |
|battery |---|Battery Isolate |-NO-|or (12).     |-NO-|Battery    |
|control |    |Magnetic        |    |Check that   |    |Isolate    |
|switch  |    |Indicator (7) or|    |the BATT     |    |Contactor  |
|to "BATT|    |(8) displays    |    |ISOLATE Cap- |    |(5) or     |
|OFF".   |    |cross-line.     |    |tion Light   |    |(6).       |
 --------      ----------------     |Module (3) or|     -----------
                      |             |(4) is       |
                     YES            |illuminated. |
                      |              -------------
                      |                    |
                      |                   YES
                      |                    |
                      |              ----------------
                      |             |Renew Battery   |
                      |             |Control Switch  |
                      |             |(9) or (10).    |
                      |              ----------------
                      |
```

Continued on Sheet 2

Chart 114 (Sheet 1 of 2)

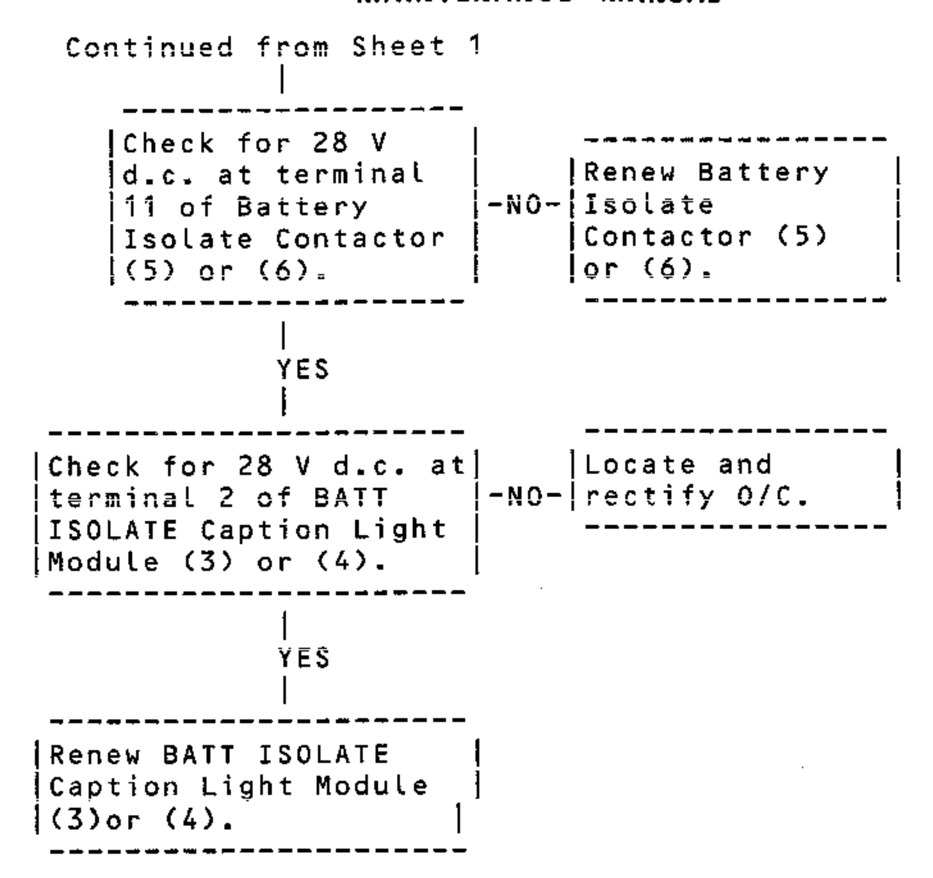


Chart 114 (Sheet 2 of 2)

```
*******************************
*ASB POSITION MAGNETIC        *
*INDICATOR REMAINS CROSS-LINE *
*WHEN EMERGENCY GENERATOR MODE*
*SWITCH IS SET TO 'GRD BY-    *
*PASS' WITH NO.1 OR NO.2      *
*ENGINE HP RPM (N2) INDICATOR *
*READING APPROXIMATELY 65     *
*PER CENT N2.                 *
*******************************
```

GROUND EQUIPMENT REQUIRED

DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 -----------------       ------------------        ---------------
|Set emergency    |     |Check for 28 V d.c.|     |*Renew Engine  |
|generator mode   |---|at terminal 1 of   |--NO-|Speed Unit (95).|
|switch to "GRD BY-|    |ASB (100).         |     ---------------
|PASS". Ensure that|     ------------------
|a reading of     |              |
|approximately    |             YES
|65 per cent N2 is|              |
|given on the     |      ------------------        ---------------
|appropriate (No.1|     |Check for 28 V d.c.|     |*Renew ASB     |
|or No.2) engine  |     |at terminal 2 of   |-YES-|Position       |
|HP rpm (N2)      |     |ASB (100).         |     |Magnetic Indi- |
|indicator.       |      ------------------       |cator (101).   |
 -----------------               |                 ---------------
                                 NO
                                 |
                         ------------------
                        |Renew ASB (100).  |
                         ------------------
```

Chart 115

```
*******************************
*ESSENTIAL/MAIN ISOLATE       *
*MAGNETIC INDICATOR REMAINS   *
*IN-LINE WHEN ASSOCIATED      *
*ESSENTIAL/MAIN (NORM/EMERG)  *
*CONTROL SWITCH IS SET TO     *
*'EMERG' WITH EMERGENCY       *
*GENERATOR MODE SWITCH SET    *
*TO 'GRD BY-PASS' AND NO.1 OR *
*NO.2 ENGINE HP RPM (N2)      *
*INDICATOR READING            *
*APPROXIMATELY 65 PER CENT N2.*
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

```
 -----------     ------------       ------------        -----------
|Set the    |   |Check for 28|     |Check for 28|      |Locate and
|essential/ |---|V d.c. at   |-YES-|V d.c. at   |-YES-|rectify     |
|main (NORM/|   |terminal 11 |     |terminal X1 |      |stray posi-|
|EMERG)     |   |of Essential|     |of Essential|      |tive supply|
|control    |   |/Main       |     |/Main       |      |at terminal|
|switch to  |   |Change-over |     |Change-over |      |X1.        |
|"EMERG".   |   |Contactor   |     |Contactor   |       -----------
 -----------    |(54),(55),  |     |(54),(55),  |
                |(56) or (57)|     |(56) or (57)|
                 ------------       ------------
                      |                  |
                      NO                 NO
                      |                  |
                --------------     --------------
               |Renew         |   |Renew         |
               |Essential/Main|   |Essential/Main|
               |Isolate       |   |Change-over   |
               |Magnetic      |   |Contactor     |
               |Indicator (58)|   |(54),(55),(56)|
               |(59),(60) or  |   |or (57).      |
               |(61).         |    --------------
                --------------
```

Chart 116

```
*******************************
*BOTH 26 V AC 'A' MAIN AND    *
*ESSENTIAL BUSBARS 'DEAD' OR  *
*BOTH 26 V AC 'B' MAIN AND    *
*ESSENTIAL BUSBARS 'DEAD' WITH*
*GROUND POWER SWITCHED ON.    *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

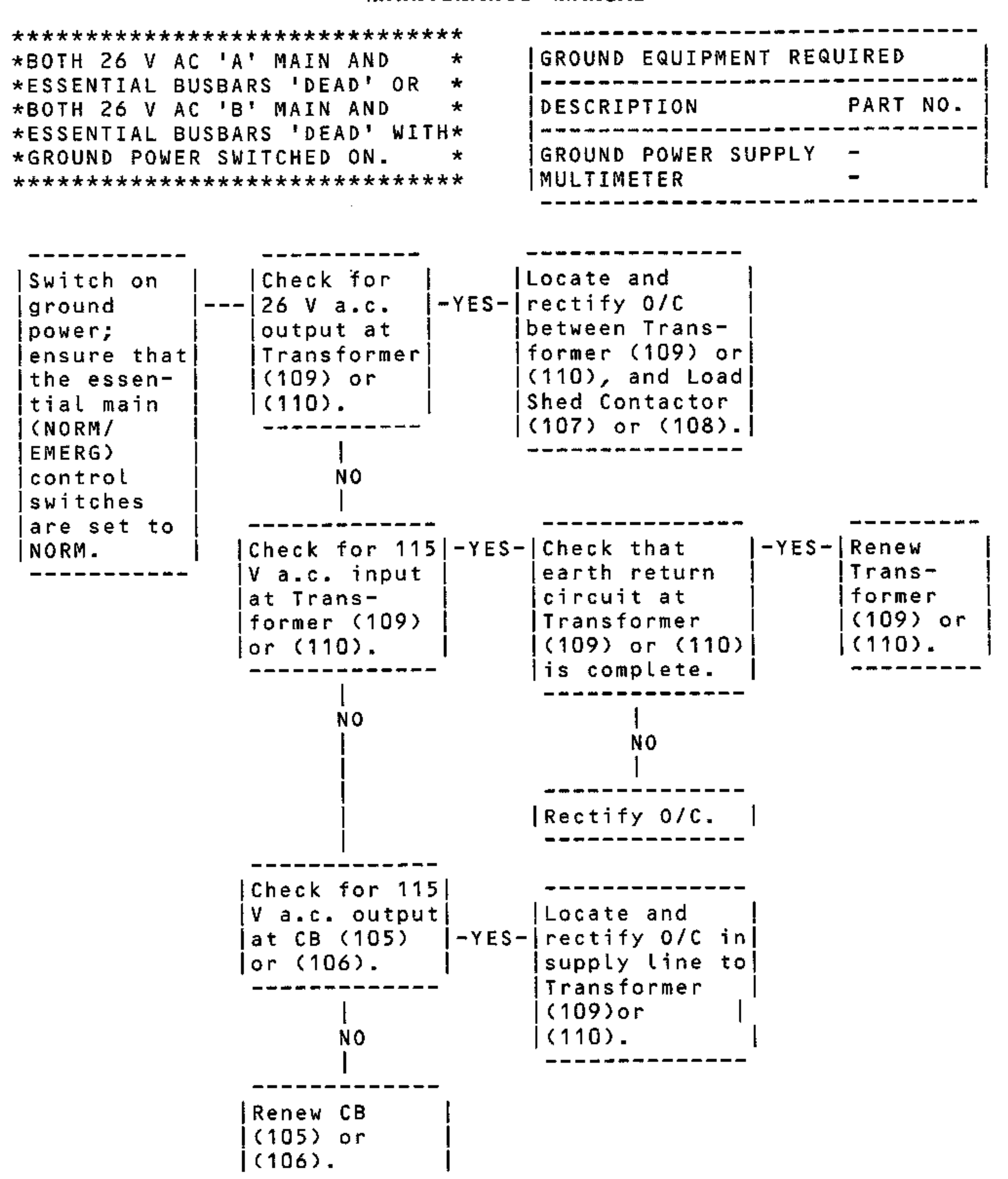


Chart 117

END OF THIS SECTION

NEXT

26 V AND 115 V AC STANDBY BUSBARS REMAIN 'DEAD' WITH GROUND POWER ON AND LEFT-HAND 'RAT' CONTROL SWITCH SET TO 'TEST'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renwal of components (*), check the associated wiring for continuity.

Connect and switch on electrical ground power. Hold the left-hand RAT control switch at "TEST".

Hold the right-hand RAT control switch at "TEST". Check that fault has cleared.

- YES: *Renew left-hand Ram Air Turbine (RAT) Control Switch (117).
- NO: Release right-hand RAT control switch only. Check for 28 V d.c. output at CB (120).
  - NO: Renew CB (120).
  - YES: Remove Static Inverter (121). With left-hand RAT control switch held at "TEST", check 28 V d.c. supply at pin 16 of static inverter connector X-140A.
    - YES: *Renew Static Inverter (121).
    - NO: Renew Static Inverter Control Relay (116) and reinstall Static Inverter (121).

Chart 118

****
WITH DORMANT CIRCUIT TEST SET
SWITCH S1 SET TO POSITION '7'
*AND THE GCB CONTROL SWITCH *
*SET TO 'ON', THE ASSOCIATED *
*GCB POSITION MAGNETIC *
INDICATOR REMAINS CROSS-LINE.
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

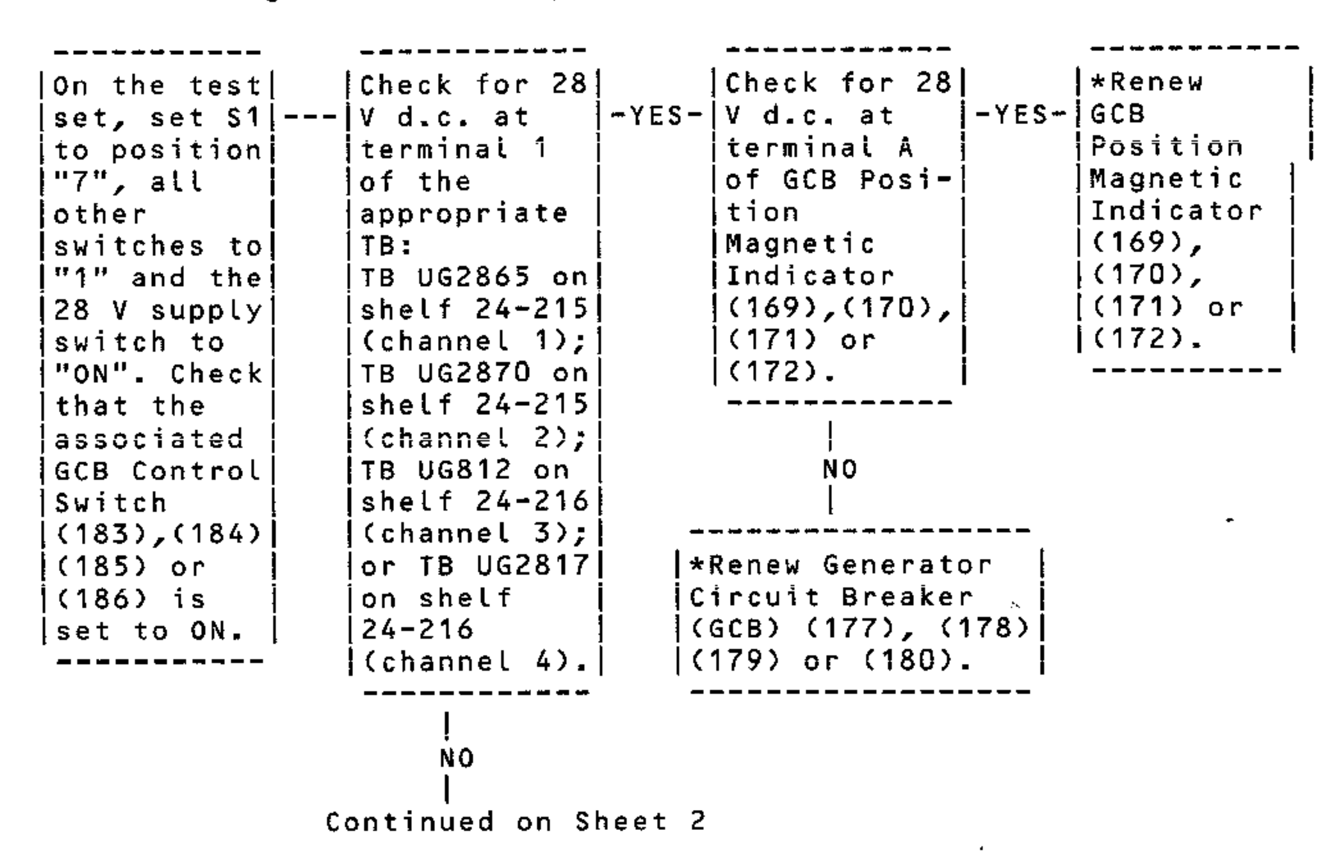


Chart 119 (Sheet 1 of 2)

Continued from Sheet 1

NO

Disconnect the test set and remove the Control and Protection Unit (CPU) (128), (129), (130) or (131). With the associated generator control switch set to ON, check continuity between pin 21 of the CPU rack connector and terminal 1 of the appropriate TB: TB UG2865, TB UG2870 TB UG2812 or TB UG2817.

-YES- Renew the CPU (183), (184),(185) or (186) and repeat the Dormant Circuits Functional Test for the affected channel (Ref. para. 10.).

-NO- Locate and rectify O/C. If O/C is at switch terminals, renew Generator Control Switch (183), (184), (185) or (186). Refit CPU (128). (129), (130) or (131) and repeat the Dormant Circuits Functional Test for the affected channel (Ref. para.10.).

Chart 119 (Sheet 2 of 2)

EFFECTIVITY: 001-006,

BA

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****
*AN ENGINE RELIGHT BUSBAR *
*'POWER ON' NEON INDICATOR *
REMAINS OUT WITH POWER ON AND
*'EMERG RELIGHT BUSBAR' *
SELECTOR SWITCH SET TO 'OFF'.
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

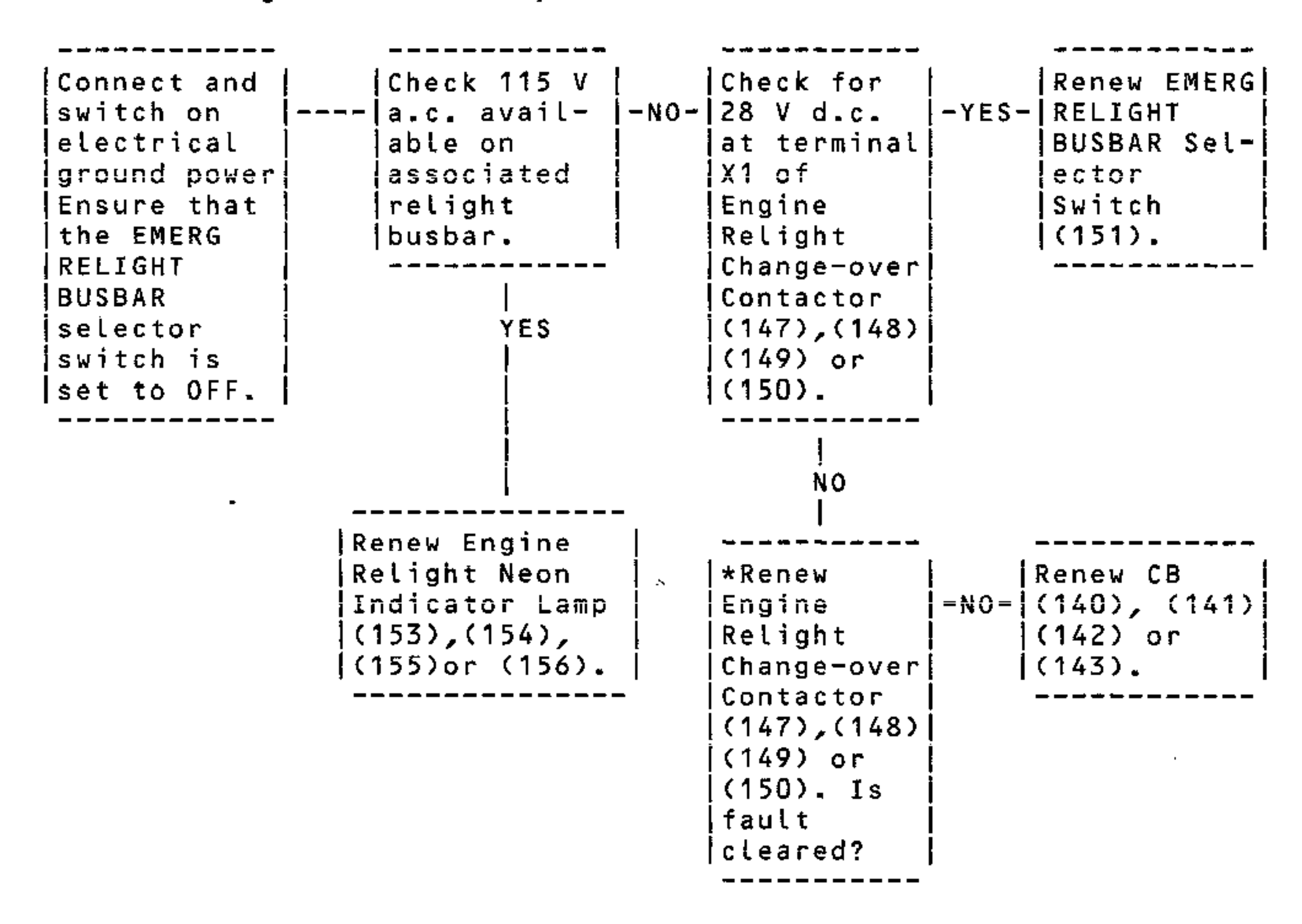


Chart 120

R **ON A/C 001-006,

```
*******************************
*VOLTAGE AND FREQUENCY NOT    *
*INDICATED AND NEON INDICATOR *
*LAMP OUT, WITH EMERGENCY     *
*GENERATOR 'FAIL' AND         *
*'SELECTED' CAPTIONS ILLUMI-  *
*NATED, AC FREQ/VOLTS SELECTOR*
*SWITCH SET TO 'EMERG PWR',   *
*EMERGENCY GENERATOR MODE     *
*SWITCH SET TO 'MANUAL' AND   *
*NOS.1 AND 2 'NORM/EMERG'     *
*CONTROL SWITCHES SET TO      *
*'EMERG'.                     *
*******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-
GROUND HYDRAULIC SUPPLY	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 ------------     ------------       ------------
|Connect and |   |Press-to-   |     |Check that  |      Continued
|switch on   |---|test the    |-NO-|the Emerg-  |-YES  on Sheet 2
|electrical  |   |emergency   |    |ency Gener- |
|ground      |   |generator   |    |ator (162)  |
|power; pres-|   |FAIL cap-   |    |is rotating.|
|surize green|   |tion. Check |     ------------
|hydraulic   |   |that fault  |          |
|system (Ref.|   |has cleared.|          NO
|Chap.29).   |    ------------           |
|Set the AC  |         |            ------------        -----------
|FREQ/VOLTS  |        YES          |Set emerg-  |      |Renew      |
|selector    |         |           |ency gener- |-YES-|Emergency  |
|switch to   |    ------------     |ator mode   |      |Generator  |
|"EMERG PWR",|   |Check the   |    |switch to   |      |and Drive  |
|the emerg-  |   |fault indi- |    |"AUTO" and  |      |Unit (162).|
|ency gener- |   |cators on   |    |then back to|       -----------
|ator mode   |   |the Emerg-  |    |"MANUAL"    |
|switch to   |   |ency Gener- |    |while       |
|"MANUAL" and|   |ator Control|    |listening   |
|Nos.1 and 2 |   |and Protec- |    |for opera-  |
|NORM/EMERG  |   |tion Unit   |    |tion of the |
|control     |   |(CPU) (88); |    |Emergency   |
|switches to |   |See NOTE on |    |Generator   |
|"EMERG".    |   |Sheet 3.    |    |Hydraulic   |
 ------------     ------------     |Selector    |
                                   |Valve (152).|
                                    ------------
                                         |NO
                                Continued on Sheet 2
```

8

Chart 121 (Sheet 1 of 3)

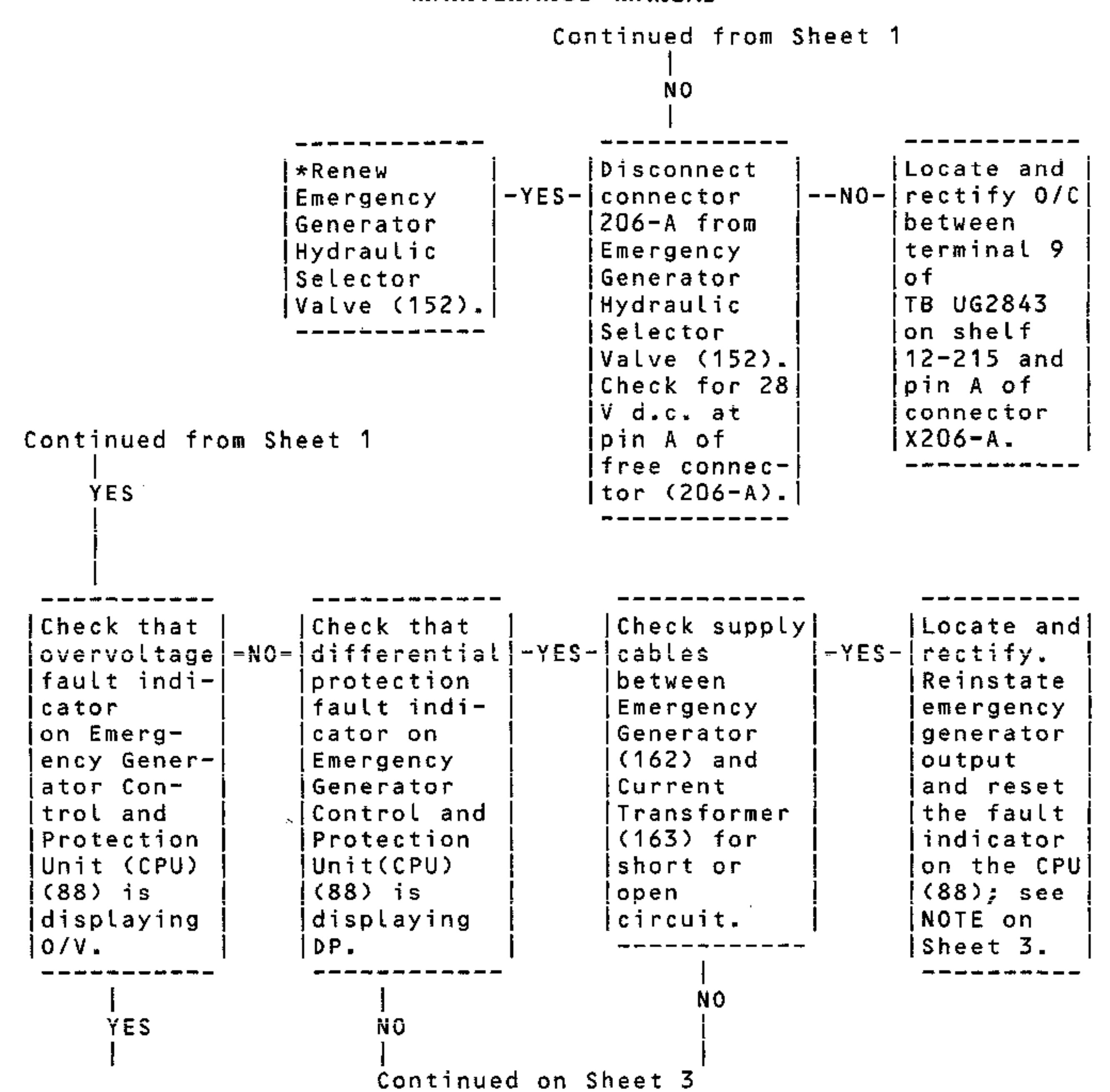
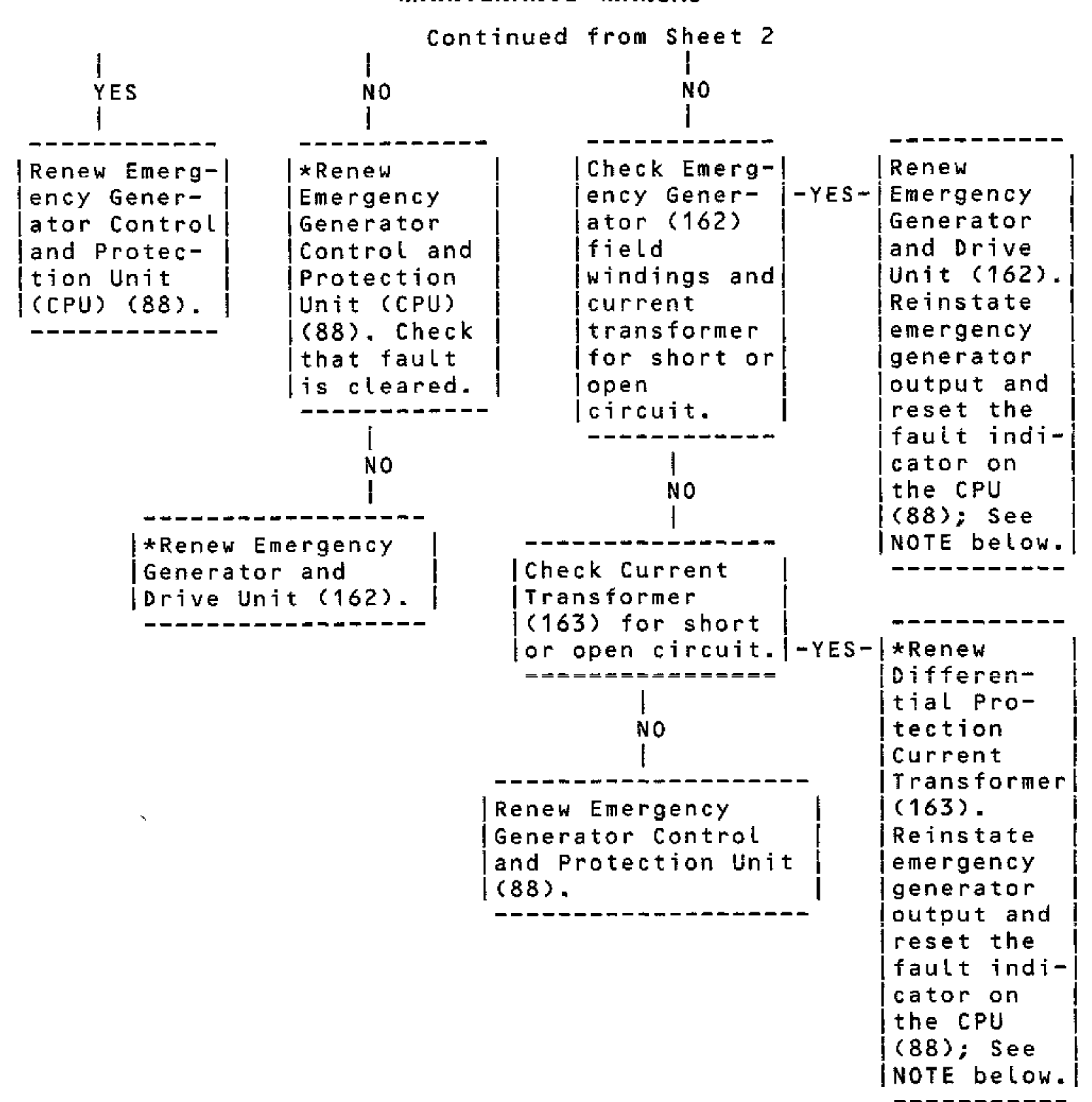


Chart 121 (Sheet 2 of 3)

Continued from Sheet 2



NOTE: With the emergency generator running on test after clearance of an O/V or DP fault, the FAIL caption must be pressed-to-test (CPU reset) to reinstate the generator output, and the fault indicator on the CPU (88) must be reset by insertion of a suitable probe through the CPU front panel to activate the appropriate reset microswitch, SW1 (O/V) or SW5 (DP).

Chart 121 (Sheet 3 of 3)

```
******************************
*A 'GEN' FAILURE CAPTION     *
*REMAINS EXTINGUISHED WITH   *
*ELECTRICAL GROUND POWER     *
*AVAILABLE AND ASSOCIATED    *
*ENGINE STOPPED.             *
******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 ----------------     ----------------      ----------------
|Connect and     |   |Check for 28 V  |    |*Renew GCB (177),|
|switch on elec- |---|d.c. at terminal|-NO-|(178), (179) or  |
|trical ground   |   |2 of GEN Caption|    |(180).           |
|power with all  |   |Light Module    |     ----------------
|engines stopped.|   |(173), (174),   |
 ----------------    |(175) or (176). |
                      ----------------
                             |
                            YES
                             |
                      -----------------
                     |*Renew GEN Caption|
                     |Light Module (174)|
                     |(175) or (176).   |
                      -----------------
```

Chart 122

```
********************************
*A "CSD' FAILURE CAPTION       *
*REMAINS EXTINGUISHED WITH     *
*ELECTRICAL GROUND POWER       *
*AVAILABLE AND ENGINES         *
*STOPPED.                      *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

Connect and switch on electrical ground power with all engines stopped.

Press-to-test the extinguished CSD failure caption. Check that the caption is illuminated.

- YES → Disconnect the electrical connector from the associated IDG oil low pressure warning switch e.g., connector 1X1C from Switch (191) (caption CSD 1); connector 2X1C from switch (192) (caption CSD 2); connector 3X1C from switch (193) (caption CSD 3); connector 4X1C from Switch (194) (caption CSD 4). Link pins A and B of the free connector and check that the associated CSD caption is illuminated.
  - YES → Renew IDG Oil Low Pressure Warning Switch (191), (192), (193) or (194).
- NO → Check for 28 V d.c. output at appropriate supply CB: CB (187) (caption CSD 2) CB (188) (caption CSD 1); CB (189) (caption CSD 4); CB (190) (caption CSD 3).
  - YES → Locate and rectify O/C.
  - NO → Renew CB (187) (188), (189) or (190).

Continued on Sheet 2

Chart 123 (Sheet 1 of 2)

Continued from Sheet 1

```
                                                      |
                                                      NO
                                                      |
 ------------------      ------------------         -------------
|Renew CSD Caption |    |Check for contin- |       |Locate and   |
|Light Module (195)|-YES-|uity of wiring    |-NO-|rectify O/C. |
|(196), (197) or   |    |between terminal 2|       |Remove link  |
|(198). Remove link|    |of CSD caption and|       |from pins A  |
|from pins A and B |    |earth via linked  |       |and B of     |
|of connector and  |    |pins A and B of   |       |connector and|
|reconnect to      |    |associated IDG oil|       |reconnect to |
|associated IDG oil|    |low pressure      |       |associated   |
|low pressure      |    |warning switch    |       |IDG oil low  |
|warning switch.   |    |'free' connector. |       |pressure     |
|Tighten and wire- |     ------------------        |warning      |
|lock the connector|                               |switch.      |
|(Ref. Wiring      |                               |Tighten and  |
|Diagram Manual,   |                               |wire-lock the|
|(20-42-48).       |                               |connector    |
 ------------------                                |(Ref. Wiring |
                                                   |Diagram      |
                                                   |Manual,      |
                                                   |20-42-48).   |
                                                    -------------
```

Chart 123 (Sheet 2 of 2)

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```
********************************
*WITH AN ENGINE RUNNING ABOVE *
*A SPEED OF 62 PER CENT N2,   *
*THE ASSOCIATED 'CSD' FAILURE *
*CAPTION REMAINS ILLUMINATED  *
*WITH THE ASSOCIATED 'GEN'    *
*FAILURE CAPTION EXTINGUISHED.*
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

Shut down all running engines (Ref. Chap. 71).

→ At the associated IDG (199),(200),(201) or (202), inspect the magnetic drain plug for evidence of contamination and the differential pressure indicators on the charge oil and scavenge filters for indication of filter blockage and take action as required (Ref. 24-11-11, Inspection/Check). Check that further running of the IDG is permitted by the Inspection/Check requirements.

- YES → Check that the IDG is is correctly filled and primed with oil (Ref. 24-11-11, Servicing). Check that the transmission is engaged, by pulling the disconnect reset handle at the bottom of the IDG. Start and run the associated engine at a speed above 62 per cent N2, (Ref. Preparation, para.2.L., and 71-00-00). Check that fault has cleared.
  - NO ↓
- NO ↓

Continued on Sheet 2

Chart 124 (Sheet 1 of 2)

Continued from Sheet 1

NO (left branch)

Renew IDG (199),(200),(201) or (202).

NO (right branch)

Shut down the associated engine (Ref. Chap.71). Disconnect the electrical connector from the associated IDG oil low pressure warning switch, e.g., connector 1X1C from Switch (191) (caption CSD 1); connector 2X1C from Switch (192)(caption CSD 2); connector 3X1C from Switch (193) (caption CSD 3); connector 4X1C from Switch (194) (caption CSD 4). Check that the associated CSD caption is extinguished.

-YES-

Renew the associated IDG Oil Low Pressure Warning Switch (191),(192),(193) or (194). Start and run the associated engine at a speed above 62 per cent N2 (Ref. Preparation, para.2.L., and 71-00-00). Check that fault has cleared.

NO

Renew IDG (199), (200),(201) or (202).

NO

Locate and rectify stray earth between terminal 2 of CSD Caption Light Module (195), (196), (197) or (198) and associated IDG oil low pressure switch 'free' connector. Refit the connector. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

Chart 124 (Sheet 2 of 2)

```
********************************
*WITH ANY ONE ENGINE RUNNING   *
*ABOVE A SPEED OF 62 PER CENT  *
*N2, THE ASSOCIATED 'GEN'      *
*FAILURE CAPTION REMAINS       *
*ILLUMINATED WITH THE ASSOCI-  *
*ATED GCB POSITION MAGNETIC    *
*INDICATOR DISPLAYING CROSS-   *
*LINE.                         *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-
DORMANT CIRCUIT TEST SET	TE 5002000

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 -----------     -----------------------------
|With the   |   |Check that the indicated     |
|engine     |---|output of the generator is   |
|running at |   |correct, i.e., 115(+3 -5) V, |
|a speed    |   |400(±4) Hz.                  |
|above 62   |    -----------------------------
|per cent N2|         |                |
|set the AC |        YES               NO
|FREQ/VOLTS |         |                |
|selector   |     Continued        Continued
|switch to  |     on Sheet 2       on Sheet 2
|"GEN 1, 2, |
|3 or 4", as|
|appropriate|
|and hold   |
|the associ-|
|ated gener-|
|ator con-  |
|trol switch|
|at "TEST". |
|Check and  |
|record     |
|indicated  |
|generator  |
|output     |
|voltage and|
|frequency. |
 -----------
```

Chart 125 (Sheet 1 of 4)

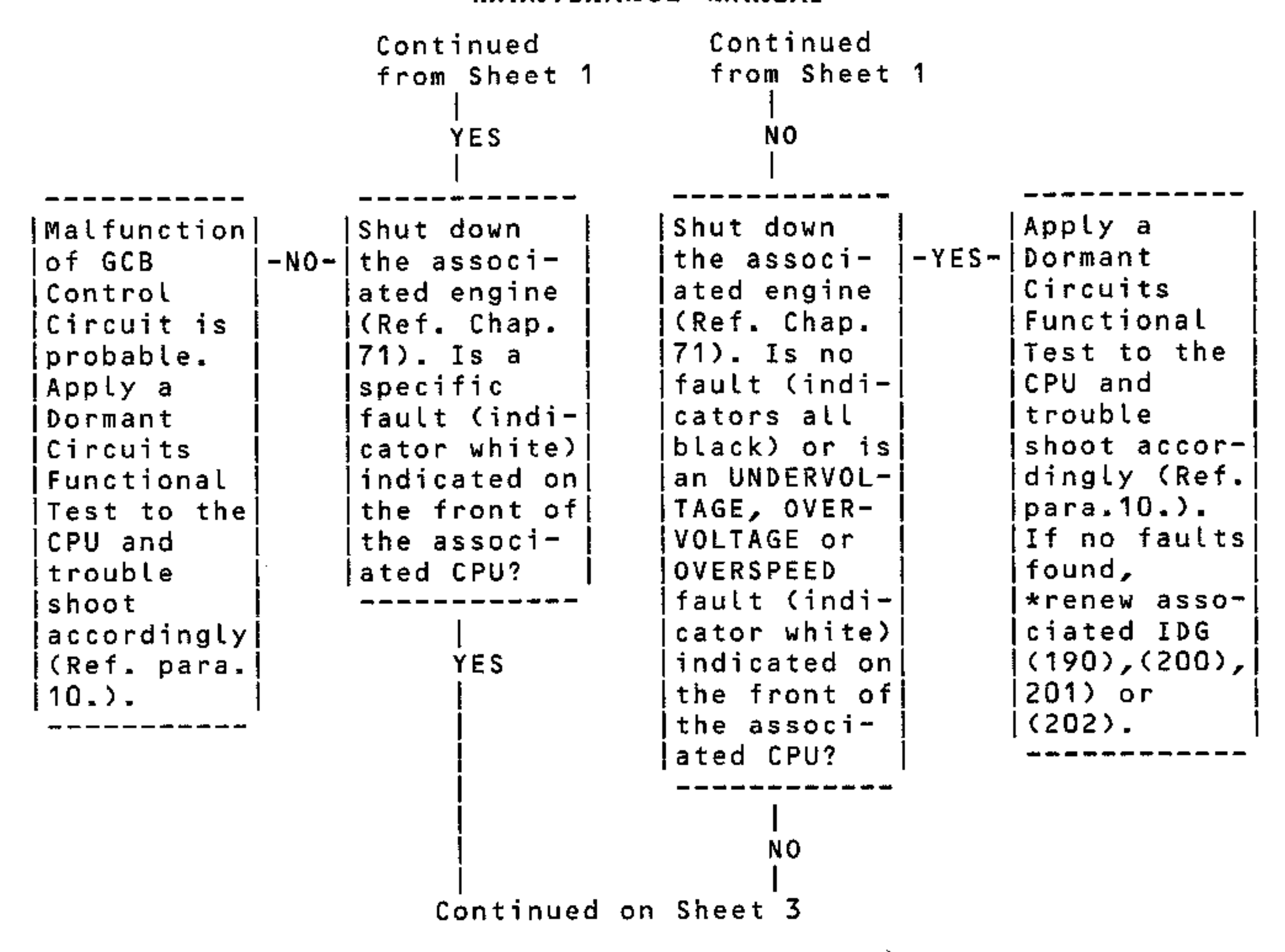


Chart 125 (Sheet 2 of 4)

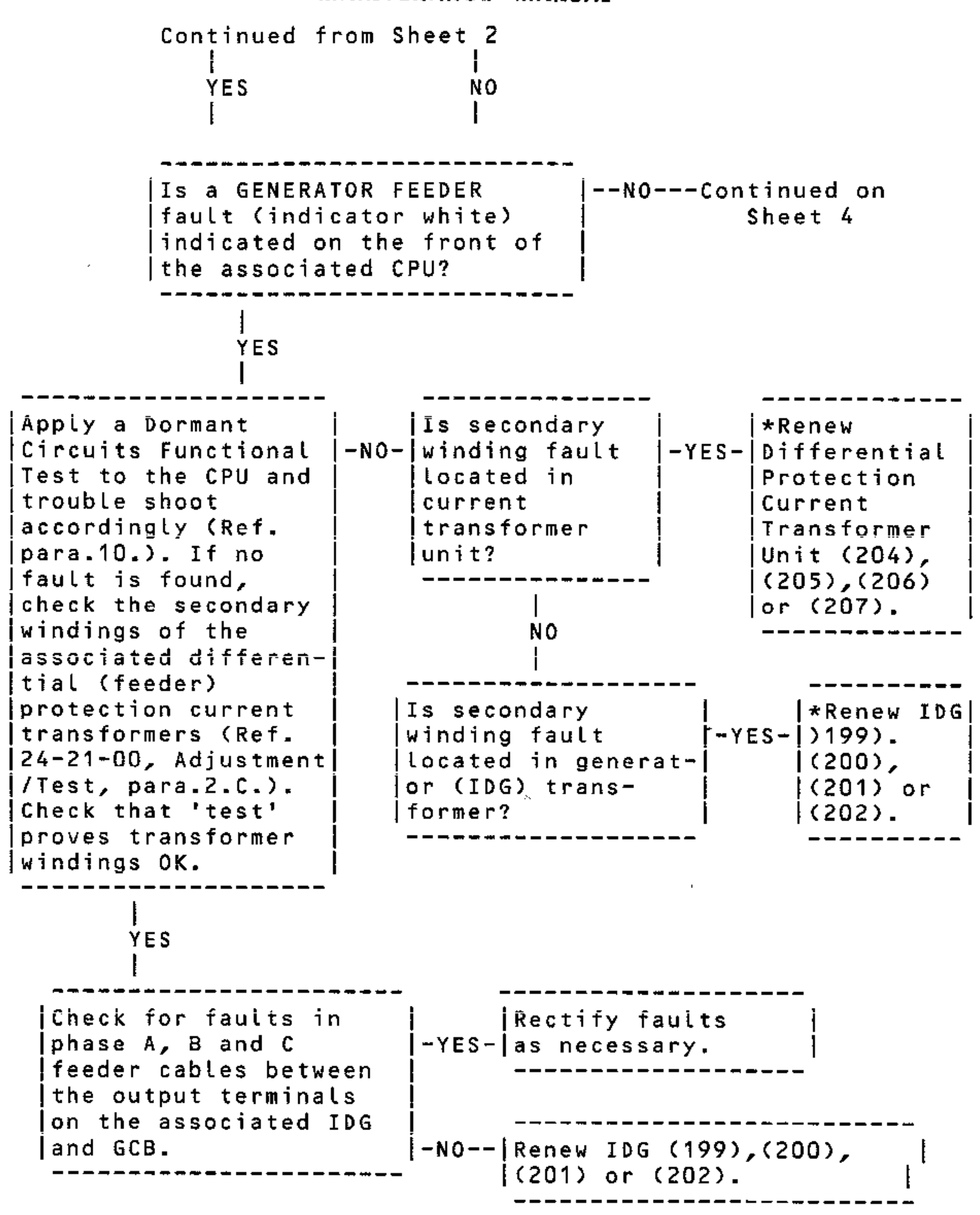


Chart 125 (Sheet 3 of 4)

```
                    -----------------------------
Continued-------|Is a BUSBAR fault (indicator |
from Sheet 3    |white) indicated on the front|
                |of the associated CPU?       |
                 -----------------------------
                        |
                       YES
                        |
 -------------------------------              --------------------
|Apply a Dormant Circuits        |       |Renew faulty cables |
|Functional Test to the CPU and  |-YES-|as necessary.       |
|trouble shoot accordingly (Ref.|       --------------------
|para.10.). if no faults found,  |
|isolate the electrical genera-  |
|tion and external power         |
|supplies (Ref. Servicing). In   |
|each generation channel, check  |
|for faults in feeder cables     |
|between the GCB and the         |
|distribution busbars.           |
 -------------------------------
                |
               NO
                |
 ------------------------------------------
|*Renew the GCB (177),(178),(179) or (180).|
 ------------------------------------------
```

Chart 125 (Sheet 4 of 4)

ASB POSITION MAGNETIC INDICATOR REMAINS CROSS-LINE WITH NO.1 ENGINE RUNNING ABOVE A SPEED OF 62 PER CENT N2.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Shut down No.1 engine (Ref. 71-00-00). Ensure that operation of the ASB has been checked and cleared in accordance with procedures detailed in paragraph 4., Emergency Generation - Preliminary.

→ Check the Engine Pulse Probe Unit (164) in accordance with the applicable test procedures (Ref. 71-50-00, Adjustment/Test. Check that the test requirements are met.

- YES → *Renew Engine Speed Unit (95). Check that fault is cleared.
  - NO → Renew Engine Pulse Probe Unit (164).
- NO → *Renew Engine Pulse Probe Unit (164).

Chart 126

```
******************************
*WITH TWO OR MORE ENGINES    *
*RUNNING ABOVE A SPEED OF 62 *
*PER CENT N2, A 'GEN'        *
*FAILURE CAPTION REMAINS     *
*ILLUMINATED WITH THE ASSOCI-*
*ATED GCB POSITION MAGNETIC  *
*INDICATOR DISPLAYING CROSS- *
*LINE.                       *
******************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-
DORMANT CIRCUIT TEST SET	TE 5002000

NOTE: Before renewal of components (*), check the associated wiring for continuity.

With the engine running at a speed above 62 per cent N2 set the AC FREQ/VOLTS selector switch to "GEN 1, 2, 3 or 4", as appropriate and hold the associated generator control switch at "TEST". Check and record indicated generator output voltage and frequency.

→ Check that the indicated output of the generator is correct, i.e., 115(+3 -5) V, 400(±4) Hz.

YES: Continued on Sheet 2

NO: Continued on Sheet 2

Chart 127 (Sheet 1 of 3)

Continued from Sheet 1 — YES

Shut down the associated engine (Ref. Chap. 71). Is a specific fault (indicator white) indicated on the front of the associated CPU?

- NO → Malfunction of GCB Control Circuit is probable. Apply a Dormant Circuits Functional Test to the CPU and trouble shoot accordingly (Ref. para. 10.). If no fault is found, CPU control circuit to earth via contacts of GPB is suspect. *Renew GPB (203).
- YES → Continued on Sheet 3

Continued from Sheet 1 — NO

Shut down the associated engine (Ref. Chap. 71). Is no fault (indicators all black) or is an UNDERVOLTAGE, OVERVOLTAGE or OVERSPEED fault (indicator white) indicated on the front of the associated CPU?

- YES → Apply a Dormant Circuits Functional Test to the CPU and trouble shoot accordingly (Ref. para.10.). If no faults found, *renew associated IDG (190),(200),(201) or (202).
- NO → Continued on Sheet 3

Chart 127 (Sheet 2 of 3)

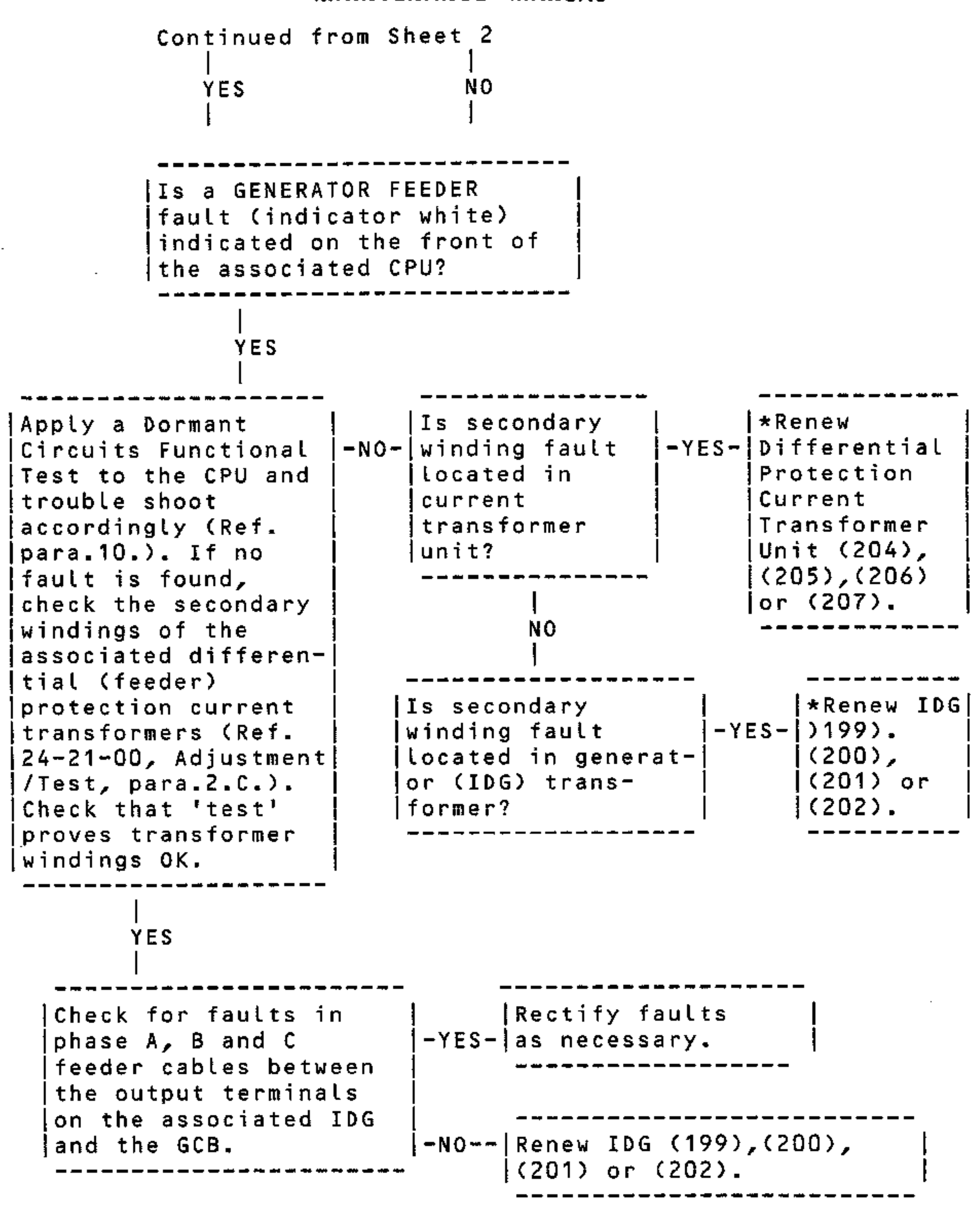


Chart 127 (Sheet 3 of 3)

```
********************************
*VOLTAGE AND FREQUENCY ARE NOT*
*DISPLAYED WHEN THE ASSOCIATED*
*GENERATOR IS SELECTED AT THE *
*AC FREQ/VOLTS SELECTOR SWITCH*
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

The associated checks on the initial application of electrical ground power prove the serviceability of the voltmeter and frequency meter (Ref. 24-41-00).

```
 -----------------      -------------------        ----------------
|Shut down the    |    |With the associated|      |Renew Circuit   |
|running engines  |----|generator selected |-YES-|Breaker (165),  |
|(Ref. Chap.71).  |    |on the AC FREQ/    |      |(166),(167), or |
 -----------------     |VOLTS selector     |      |(168).          |
                       |switch, check for  |       ----------------
                       |continuity between |
                       |pin A of the a.c.  |
                       |test socket D116-A |
                       |on panel 18-216 and|
                       |terminal A2 of the |
                       |associated supply  |
                       |circuit breaker    |
                       |(165), (166),      |
                       |(167) or (168).    |
                        -------------------
                                |
                                NO
                                |
                        --------------------
                       |*Renew AC FREQ/VOLTS|
                       |Selector Switch     |
                       |(161).              |
                        --------------------
```

Chart 128

R **ON A/C 001-006,

```
********************************
*WITH TWO OR MORE ENGINES      *
*RUNNING AT A SPEED ABOVE 62   *
*PER CENT N2, A BTB POSITION   *
*MAGNETIC INDICATOR DISPLAYS   *
*CROSS-LINE.                   *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	-
MULTIMETER	-
DORMANT CIRCUIT TEST SET	TE 5002000

NOTE: Before renewal of components (*), check the associated wiring for continuity.

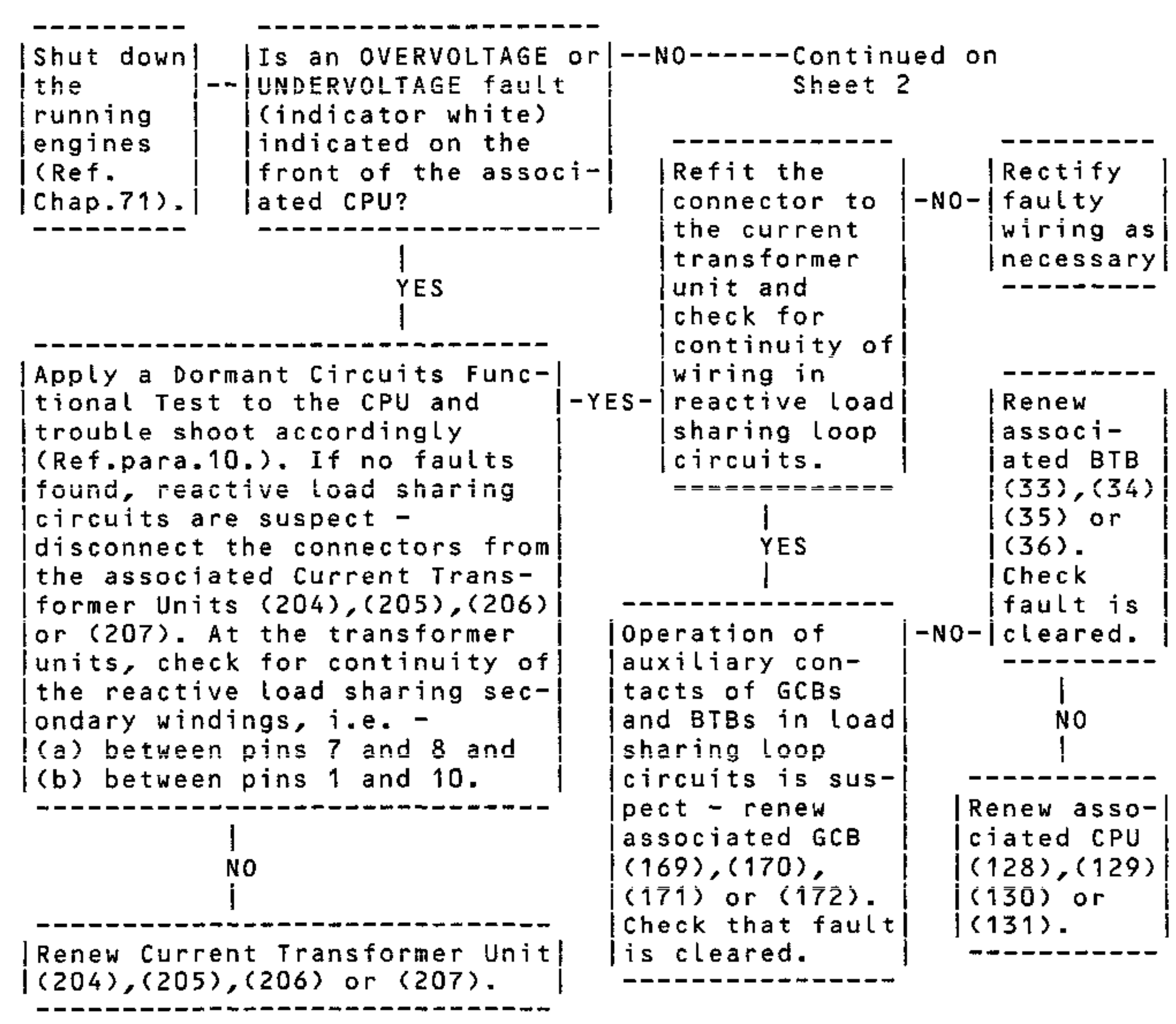


Chart 129 (Sheet 1 of 3)

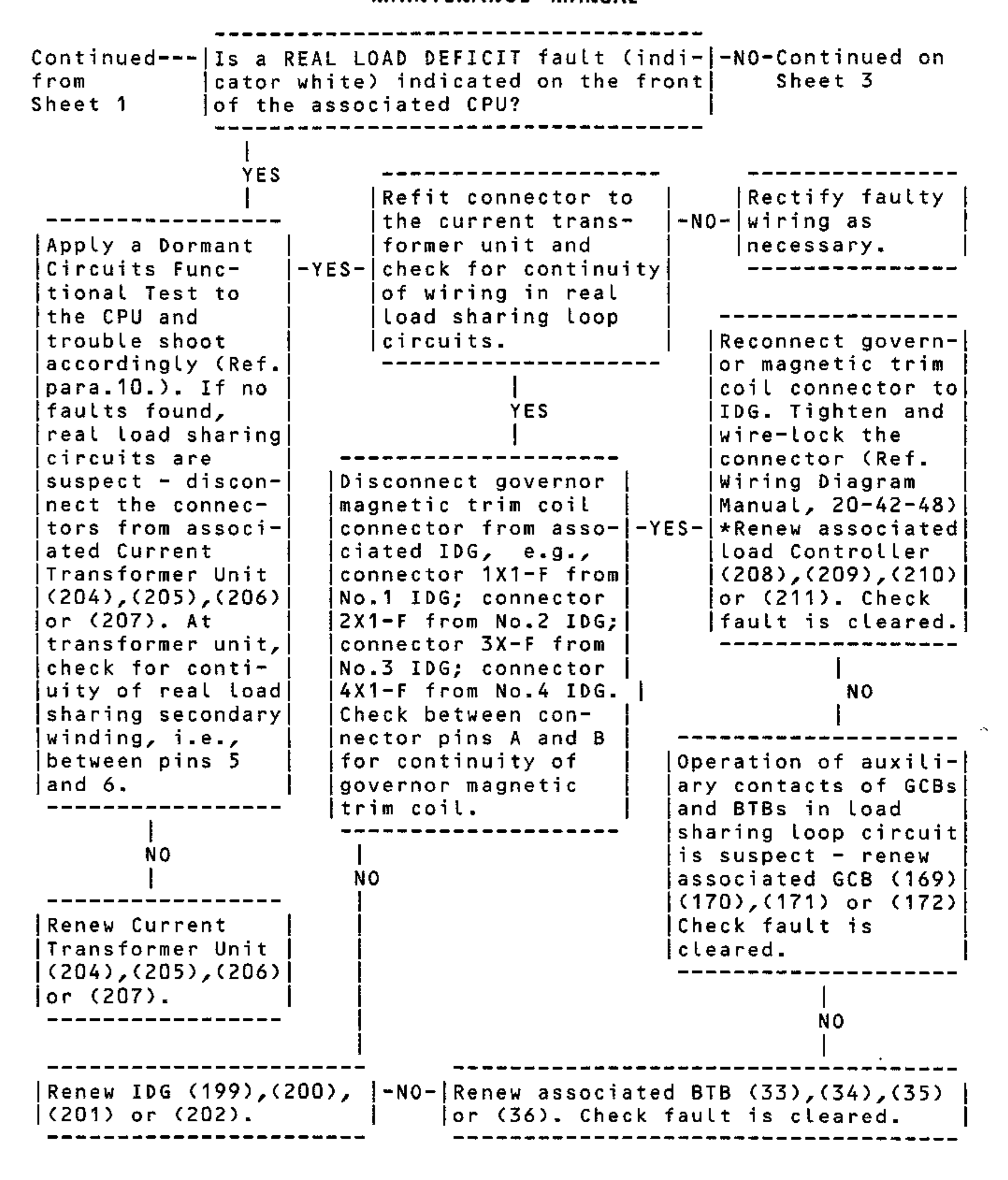


Chart 129 (Sheet 2 of 3)

```
                         -----------------
Continued------|Is a BUSBAR fault|
from           |(indicator white)|
Sheet 2        |indicated on the |
               |front of the     |
               |associated CPU?  |
                -----------------
                        |
                       YES
                        |
            ------------------------         -----------------
           |Apply a Dormant Circuits|       |Rectify faults as|
           |Functional Test to the  |-YES-|necessary.       |
           |CPU and trouble shoot   |       -----------------
           |accordingly. (Ref.      |
           |para.10.).  If no faults|
           |found, isolate the      |
           |electrical generation   |
           |and external power      |
           |supplies (Ref.          |
           |Servicing). Check for   |
           |faults on the synchro-  |
           |nizing busbars (bus-tie |
           |bars) between the BTBs. |
            ------------------------
                        |
                        NO
                        |
            ------------------------
           |*Renew the associated   |
           |BTB (33),(34),(35) or   |
           |(36).                   |
            ------------------------
```

Chart 129 (Sheet 3 of 3)

****
WITH THE ASSOCIATED GENERATOR
*ON-LINE, A KW/KVAR METER *
*GIVES ZERO 'KW' INDICATION *
*('PUSH FOR KVAR' SWITCH *
*RELEASED). *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Shut down the running engines (Ref. Chap.71). Disconnect the electrical connector from the affected KW/KVAR meter e.g., connector 1X282-A from No.1 Meter (212); connector 2X282-A from No.2 Meter (213); connector 3X282-A from No.3 Meter (214); connector 4X282-A from No.4 Meter (215).

Check for continuity between pin E of the 'free' connector 1X282-A, 2X282-A, 3X282-A or 4X282-A and terminal A2 of the associated Circuit Breaker (165),(166), (167) or (168).

- YES → Check earth potential at pin B of the 'free' connector 1X282-A, 2X282-A, 3X282-A or 4X282-A.
  - YES → Continued on Sheet 2
  - NO → Renew the associated C/O relay
- NO → Renew the associated C/O relay

Renew the associated C/O relay i.e., *renew Nos.1 & 2 KW/KVAR meters C/O relay (224) or *renew Nos.3 & 4 KW/KVAR meters C/O Relay (225). Refit the connector to the associated KW/KVAR Meter (212),(213), (214) or (215).

Chart 130 (Sheet 1 of 2)

Continued from Sheet 1 → Check continuity of the associated current transformer winding between pin F and pin A of the KW/KVAR meter 'free' connector 1X282-A, 2X282-A, 3X282-A or 4X282-A.

- YES → Renew KW/KVAR Meter (212),(213),(214) or (215),together with the associated (matched) Resistor (216), (217), (218) or (219).
- NO → *Renew Current Transformer (220), (221),(222), or (223). Refit the connector to the associated KW/KVAR Meter (212), (213), (214) or (215).

Chart 130 (Sheet 2 of 2)

****
WITH THE ASSOCIATED GENERATOR
*ON-LINE, A KW/KVAR METER *
*GIVES ZERO 'KW' INDICATION *
*I.E., WHEN 'PUSH FOR KVAR' *
*SWITCH IS OPERATED. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Shut down the running engines (Ref. Chap.71).

*Renew associated C/O relay, i.e., Nos.1 & 2 KW/KVAR Meters C/O Relay (224) or Nos.3 & 4 KW/KVAR Meters C/O Relay (225). Is fault cleared?

NO

*Renew associated KW/KVAR Meter (212),(213),(214) or (215), together with the (matched) Resistor (216),(217),(218) or (219). Is fault cleared?

NO

Renew CB (165), (166), (167) or (168).

Chart 131

****
*WITH TWO OR MORE GENERATORS *
*ON-LINE. A 'KW/KVAR' METER *
*INDICATES A LOAD SHARING *
*DIFFERENCE EXCEEDING 6 kW. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

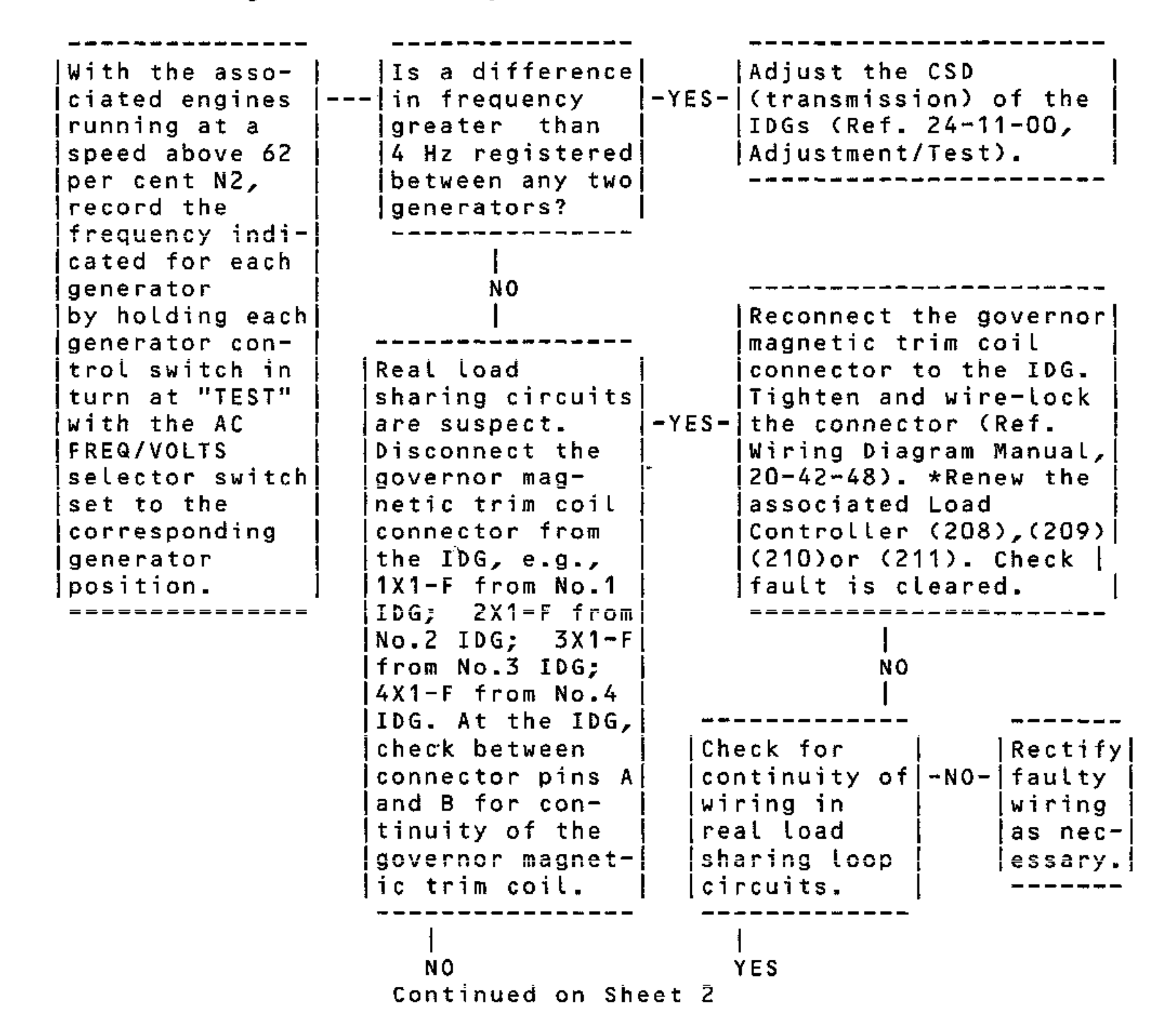


Chart 132 (Sheet 1 of 2)

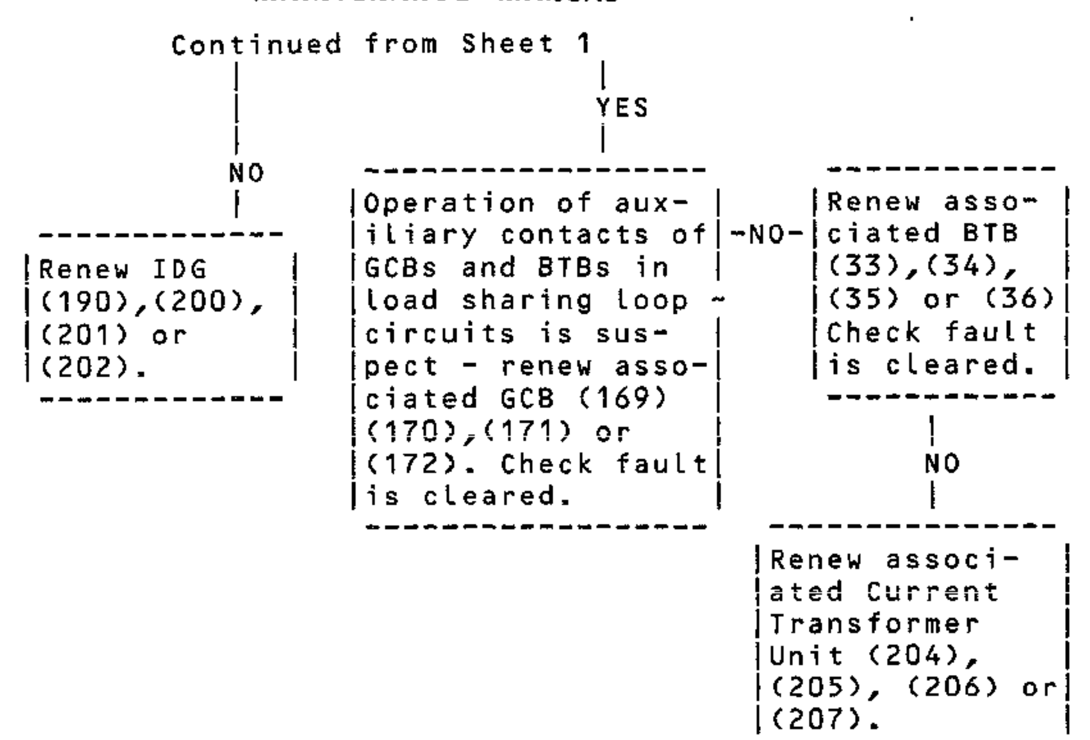


Chart 132 (Sheet 2 of 2)

```
*******************************
*WITH TWO OR MORE GENERATORS  *
*ON-LINE, A 'KW/KVAR' METER   *
*INDICATES A LOAD SHARING     *
*DIFFERENCE EXCEEDING 4 kVAR. *
*******************************
```

GROUND EQUIPMENT REQUIRED

DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 -----------------        -----------------        ------------------
|Reactive load    |      |Check for contin-|      |Operation of      |
|sharing circuits |-NO-  |uity of wiring in|-YES- |auxiliary contacts|
|are suspect. Shut|      |reactive load    |      |of GCBs and BTBs  |
|down the running |      |sharing loop     |      |in load sharing   |
|engines (Ref.    |      |circuits.        |      |loop circuits is  |
|Chap.71). *Renew |       -----------------       |suspect - renew   |
|associated CPU   |              |                |associated GCB    |
|(128),(129),     |              NO               |(169),(170),(171) |
|(130), or (131). |              |                |or (172). Check   |
|Check fault is   |       -----------------       |fault is cleared. |
|cleared.         |      |Rectify faulty   |       ------------------
 -----------------       |wiring as        |               |
                         |necessary.       |               NO
                          -----------------                |
                                                   ------------------
                                                  |Renew associated  |
                                                  |BTB (33), (34),   |
                                                  |(35) or (36).     |
                                                  |Check fault is    |
                                                  |cleared.          |
                                                   ------------------
                                                           |
                                                           NO
                                                           |
                                                   ------------------
                                                  |Renew associated  |
                                                  |Current           |
                                                  |Transformer Unit  |
                                                  |(204),(205),(206) |
                                                  |or (207).         |
                                                   ------------------
```

Chart 133

```
*********************************
*WITH THE ASSOCIATED ENGINE     *
*RUNNING AT A SPEED ABOVE 62    *
*PER CENT N2, THE TEMPERATURE   *
*INDICATED ON THE 'INLET' OR    *
*'DIFF' SCALE OF A CSD OIL      *
*TEMPERATURE INDICATOR IS       *
*ABNORMALLY HIGH OR ABNORMALLY  *
*LOW OR THE OVERHEAT WARNING    *
*LAMP ON THE INDICATOR IS LIT.  *
*CSD OIL TEMPERATURE INDICATION *
*CIRCUITS CHECKED AND FOUND     *
*CORRECT.                       *
*********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
As required by cross-reference	-

Check the record of the fault indication. ---- Does record show inlet temperature high with or without overheat warning lamp lit - differential temperature normal?

- NO -> Does record show inlet temperature normal - differential temperature high?
  - YES -> Renew IDG (199), (200), (201) or (202).
- YES -> Check that the operation of the oil cooling system is correct (Ref. Chap.79)
  - NO -> Locate and rectify fault in the oil cooling system (Ref. Chap.79).
  - YES -> Check that the IDG oil level is correct (Ref. 24-11-11, Inspection/Check).
    - YES -> Continued on Sheet 2

Chart 134 (Sheet 1 of 2)

Continued from Sheet 1

YES

Inspect the IDG magnetic drain plug for evidence of contamination and the differential pressure indicators on the charge oil and scavenge filters for indication of filter blockage and take action as required (Ref. 24-11-11, Inspection/Check). Check that further running of the IDG is permitted by the Inspection/Check requirements.

-YES-

Check that the IDG is correctly filled and primed with oil (Ref. 24-11-11, Servicing). Check that the transmission is engaged, by pulling the disconnect reset handle at the bottom of the IDG. Start and run the associated engine at a speed above 62 per cent N2, (Ref. Preparation, para.2.L., and 71-00-00). Check that fault has cleared.

NO (from Inspect the IDG magnetic drain plug)

Renew IDG (199), (200), (201) or (202).

NO (from Check that the IDG is correctly filled)

Renew IDG (199), (200), (201)or (202).

Chart 134 (Sheet 2 of 2).

****
WITH EMERGENCY GENERATOR MODE
*SWITCH AT 'GRND BY-PASS' AND *
*NO.2 ENGINE RUNNING ABOVE 62 *
*PER CENT N2, EMERGENCY *
*GENERATOR 'SELECTED' CAPTION *
*IS ILLUMINATED WHEN NO.1 *
*ENGINE IS SHUT DOWN. *
****

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
MULTIMETER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

Shut down No.2 engine (Ref. 71-00-00). Ensure that operation of the ASB has been checked and cleared in accordance with the procedures detailed in paragraph 4., Emergency Generation - Preliminary.

Check the Engine Pulse Probe Unit (164) in accordance with the applicable test procedures (Ref. 71-50-00, Adjustment/Test). Check that the test requirements are met.

- YES: *Renew Engine Speed Unit (95). Check that fault is cleared.
  - NO: Renew Engine Pulse Probe Unit (164).
- NO: *Renew Engine Pulse Probe Unit (164).

Chart 135

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ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
(1) Circuit breaker 28 V	-	1-213	1P29	Map ref.M9	24-50-00 R/I	24-31-03
(2) Circuit breaker 28 V	-	3-213	2P29	Map ref.E11	24-50-00 R/I	24-31-04
(3) BATT ISOLATE caption light module	-	6-214	1P30	3CM station	24-00-00 R/I	24-31-03
(4) BATT ISOLATE caption light module	-	6-214	2P30	3CM station	24-00-00 R/I	24-31-04
(5) Battery isolate contactor	-	12-215	1P20	Flight compartment LH racking	24-00-00 R/I	24-31-03
(6) Battery isolate contactor	-	12-216	2P20	Flight compartment RH racking	24-00-00 R/I	24-31-04
(7) Battery isolate magnetic indicator	-	6-214	1P31	3CM station	24-00-00 R/I	24-31-03
(8) Battery isolate magnetic indicator	-	6-214	2P31	3CM station	24-00-00 R/I	24-31-04
(9) Battery control switch	-	6-214	1P25	3CM station	24-00-00 R/I	24-31-03
(10) Battery control switch	-	6-214	2P25	3CM station	24-00-00 R/I	24-31-04
(11) BATT.A CONTROL circuit breaker 28 V	-	16-215	1P24	Flight compartment LH racking	24-50-00 R/I	24-31-03

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(12) BATT.B CONTROL circuit breaker 28 V	-	16-216	2P24	Flight compartment RH racking	24-50-00 R/I	24-31-04
(13) No.1 split system breaker	-	24-215	X24	Flight compartment LH racking	24-00-00 R/I	24-21-07
(14) No.2 split system breaker	-	24-216	X25	Flight compartment RH racking	24-00-00 R/I	24-21-07
(15) Split system breaker control switch	-	3-214	X26	3CM station	24-00-00 R/I	24-21-07
(16) SSB position magnetic indicator	-	3-214	X27	3CM station	24-00-00 R/I	24-21-07
(17) No.1 AC MAIN BUS caption light module	-	3-214	1X16	3CM station	24-00-00 R/I	24-51-06
(18) No.2 AC MAIN BUS caption light module	-	3-214	2X16	3CM station	24-00-00 R/I	24-51-06
(19) No.3 AC MAIN BUS caption light module	-	3-214	3X16	3CM station	24-00-00 R/I	24-51-07
(20) No.4 AC MAIN BUS caption light module	-	3-214	4X16	3CM station	24-00-00 R/I	24-51-07
(21) No.1 main a.c. undervolt unit	-	12-215	1X15	Flight compartment LH racking	24-51-11 R/I	24-51-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(22) No.2 main a.c. undervolt unit	-	12-215	2X15	Flight compartment LH racking	24-51-11 R/I	24-51-06
(23) No.3 main a.c. undervolt unit	-	12-216	3X15	Flight compartment RH racking	24-51-11 R/I	24-51-07
(24) No.4 main a.c. undervolt unit	-	12-216	4X15	Flight compartment RH racking	24-51-11 R/I	24-51-07
(25) Circuit breaker 28 V	-	1-213	1X125	Map ref.Q7	24-50-00 R/I	24-51-06
(26) Circuit breaker 28 V	-	1-213	2X125	Map ref.Q8	24-50-00 R/I	24-51-06
(27) Circuit breaker 28 V	-	3-213	3X125	Map ref.F8	24-50-00 R/I	24-51-07
(28) Circuit breaker 28 V	-	3-213	4X125	Map ref.F9	24-50-00 R/I	24-51-07
(29) No.1 BTB position magnetic indicator	-	3-214	1X10	3CM station	24-00-00 R/I	24-21-06
(30) No.2 BTB position magnetic indicator	-	3-214	2X10	3CM station	24-00-00 R/I	24-21-06
(31) No.3 BTB position magnetic indicator	-	3-214	3X10	3CM station	24-00-00 R/I	24-21-06
(32) No.4 BTB position magnetic indicator	-	3-214	4X10	3CM station	24-00-00 R/I	24-21-06
(33) No.1	-	24-215	1X6	Flight	24-00-00	24-21-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
bus-tie breaker (BTB)				compartment LH racking	R/I	
(34) No.2 bus-tie breaker (BTB)	-	24-215	2X6	Flight compartment LH racking	24-00-00 R/I	24-21-06
(35) No.3 bus=tie breaker (BTB)	-	24-216	3X6	Flight compartment RH racking	24-00-00 R/I	24-21-06
(36) No.4 bus-tie breaker (BTB)	-	24-216	4X6	Flight compartment RH racking	24-00-00 R/I	24-21-06
(37) No.1 BTB control switch	-	3-214	1X9	3CM station	24-00-00 R/I	24-21-06
(38) No.2 BTB control switch	-	3-214	2X9	3CM station	24-00-00 R/I	24-21-06
(39) No.3 BTB control switch	-	3-214	3X9	3CM station	24-00-00 R/I	24-21-06
(40) No.4 BTB control switch	-	3-214	4X9	3CM station	24-00-00 R/I	24-21-06
(41) No.1 a.c. essential undervoltage unit	-	12-215	1X127	Flight compartment LH racking	24-51-11 R/I	24-51-06
(42) No.2 a.c. essential undervoltage unit	-	12-215	2X127	Flight compartment LH racking	24-51-11 R/I	24-51-06
(43) No.3 a.c. essential undervoltage unit	-	12-216	3X127	Flight compartment RH racking	24-51-11 R/I	24-51-07
(44) No.4 a.c. essential undervoltage	-	12-216	4X127	Flight compartment RH racking	24-51-11 R/I	24-51-07

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
unit						
(45) No.1 AC ESS BUS caption light module	-	6-214	1X129	3CM station	24-00-00 R/I	24-51-06
(46) No.2 AC ESS BUS caption light module	-	6-214	2X129	3CM station	24-00-00 R/I	24-51-06
(47) No.3 AC ESS BUS caption light module	-	6-214	3X129	3CM station	24-00-00 R/I	24-51-07
(48) No.4 AC ESS BUS caption light module	-	6-214	4X129	3CM station	24-00-00 R/I	24-51-07
(49) Emergency generator KVA meter	-	6-214	X205	3CM station	24-00-00 R/I	24-22-02
(50) No.1 essential/main control switch	-	6-214	1X128	3CM station	24-00-00 R/I	24-51-06
(51) No.2 essential/main control switch	-	6-214	2X128	3CM station	24-00-00 R/I	24-51-06
(52) No.3 essential/main control switch	-	6-214	3X128	3CM station	24-00-00 R/I	24-51-07
(53) No.4 essential/main control switch	-	6-214	4X128	3CM station	24-00-00 R/I	24-51-07
(54) No.1 essential/main change-over contactor	-	12-215	1X126	Flight compartment LH racking	24-00-00 R/I	24-51-06
(55) No.2 essential/main	-	12-215	2X126	Flight compartment	24-00-00 R/I	24-51-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
change-over contactor				LH racking		
(56) No.3 essential/main change-over contactor	-	12-216	3X126	Flight compartment RH racking	24-00-00 R/I	24-51-07
(57) No.4 essential/main change-over contactor	-	12-216	4X126	Flight compartment RH racking	24-00-00 R/I	24-51-07
(58) No.1 essential/main isolate magnetic indicator	-	6-214	1X130	3CM station	24-00-00 R/I	24-51-06
(59) No.2 essential/main isolate magnetic indicator	-	6-214	2X130	3CM station	24-00-00 R/I	24-51-06
(60) No.3 essential/main isolate magnetic indicator	-	6-214	3X130	3CM station	24-00-00 R/I	24-51-07
(61) No.4 essential/main isolate magnetic indicator	-	6-214	4X130	3CM station	24-51-00 R/I	24-51-07
(62) Circuit breaker 28 V	-	1-213	1X123	Map ref.Q9	24-50-00 R/I	24-51-06
(63) Circuit breaker 28 V	-	3-213	4X123	Map ref.F10	24-50-00 R/I	24-51-07
(64) No.1 TRU ammeter	-	6-214	1P6	3CM station	24-00-00 R/I	24-31-52

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(65) No.2 TRU ammeter	-	6-214	2P6	3CM station	24-00-00 R/I	24-31-52
(66) No.3 TRU ammeter	-	6-214	3P6	3CM station	24-00-00 R/I	24-31-52
(67) No.4 TRU ammeter	-	6-214	4P6	3CM station	24-00-00 R/I	24-31-52
(68) No.1 TRU control switch	-	6-214	1P3	3CM station	24-00-00 R/I	24-31-01
(69) No.2 TRU control switch	-	6-214	2P3	3CM station	24-00-00 R/I	24-31-01
(70) No.3 TRU control switch	-	6-214	3P3	3CM station	24-00-00 R/I	24-31-02
(71) No.4 TRU control switch	-	6-214	4P3	3CM station	24-00-00 R/I	24-31-02
(72) No.1 TRU isolate contactor	-	12-215	1P2	Flight compartment LH racking	24-00-00 R/I	24-31-01
(73) No.2 TRU isolate contactor	-	12-215	2P2	Flight compartment LH racking	24-00-00 R/I	24-31-01
(74) No.3 TRU isolate contactor	-	12-216	3P2	Flight compartment RH racking	24-00-00 R/I	24-31-02
(75) No.4 TRU isolate contactor	-	12-216	4P2	Flight compartment RH racking	24-00-00 R/I	24-31-02
(76) DC MAIN BUS caption light module	-	6-214	P17	3CM station	24-00-00 R/I	24-52-04
(77) Circuit breaker 28 V	-	1-213	P16	Map ref.N9	24-50-00 R/I	24-52-04

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
(78) 'A' system essential/main split magnetic indicator	-	6-214	1P14	3CM station	24-00-00 R/I	24-52-04
(79) 'B' system essential/main split magnetic indicator	-	6-214	2P14	3CM station	24-00-00 R/I	24-52-04
(80) 'A' system DC ESS BUS caption light module	-	6-214	1P28	3CM station	24-00-00 R/I	24-52-04
(81) 'A' system essential undervolt relay	-	12-215	1P27	Flight compartment LH racking	24-00-00 R/I	24-52-04
(82) 'B' system DC ESS BUS caption light module	-	6-214	2P28	3CM station	24-00-00 R/I	24-52-04
(83) 'B' system essential undervolt relay	-	12-216	2P27	Flight compartment RH racking	24-00-00 R/I	24-52-04
(84) Circuit breaker 28 V	-	1-213	1P29	Map ref.M9	24-50-00 R/I	24-52-04
(85) Circuit breaker 28 V	-	3-213	2P29	Map ref.E11	24-50-00 R/I	24-52-04
(86) SELECTED caption light module	-	6-214	X221	3CM station	24-00-00 R/I	24-22-02
(87) FAIL caption light module	-	6-214	X222	3CM station	24-00-00 R/I	24-22-02
(88) Emergency generator control and	-	5-243	X201	Rear racking	24-22-21 R/I	24-22-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
protection unit						
(89) EMERG. POWER circuit breaker 28 V	-	23-215	X210	Flight compartment LH racking	24-50-00 R/I	24-22-02
(90) Circuit breaker 28 V	-	1-213	X211	Map ref.R9	24-50-00 R/I	24-22-01
(91) Emergency generator isolate control switch	-	6-214	X219	3CM station	24-00-00 R/I	24-22-01
(92) Emergency generator mode switch	-	6-214	X218	3CM station	24-00-00 R/I	24-22-01
(93) Circuit breaker 28 V	-	3-213	X212	Map ref.G10	24-50-00 R/I	24-22-01
(94) Diode	-	12-215	X213	Flight compartment LH racking	24-00-00 R/I	24-22-01
(95) Engine speed unit	-	1-215	X223	Flight compartment LH racking	24-22-22 R/I	24-22-01
(96) Latching relay	-	12-215	X217	Flight compartment LH racking	24-00-00 R/I	24-22-01
(97) LH weight switch operated relay	-	2-123	G308	Forward underfloor racking	32-00-00 R/I	32-61-06
(98) RH weight switch operated relay	-	3-123	G311	Forward underfloor racking	32-00-00 R/I	32-61-06
(99) Latching relay time delay	-	12-215	X231	Flight compartment LH racking	24-00-00 R/I	24-22-01

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
(100) Auto shed breaker (ASB)	-	12-215	X224	Flight compartment LH racking	24-00-00 R/I	24-51-06
(101) ASB position magnetic indicator	-	6-214	X225	3CM station	24-00-00 R/I	24-51-06
(102) Temper- ature con- trolled relay	-	7-243	X207	Rear racking	24-22-00 R/I	24-22-02
(103) Emergency generator O/HEAT caption light module	-	6-214	X209	3CM station	24-00-00 R/I	24-22-02
(104) Temper- ature con- trolled relay	-	7-243	X208	Rear racking	24-22-00 R/I	24-22-02
(105) Circuit breaker 115 V	-	2-213	1X131	Map ref.D18	24-50-00 R/I	24-23-11
(106) Circuit breaker 115 V	-	4-213	2X131	Map ref.B13	24-50-00 R/I	24-23-11
(107) 'A' system load shed contactor	-	12-215	1X133	Flight compartment LH racking	24-00-00 R/I	24-51-06
(108) 'B' system load shed contactor	-	12-216	2X133	Flight compartment RH racking	24-00-00 R/I	24-51-07
(109) 26 V a.c. transformer	-	12-215	1X132	Flight compartment LH racking	24-23-11 R/I	24-23-11
(110) 26 V a.c. transformer	-	12-216	2X132	Flight compartment RH racking	24-23-11 R/I	24-23-11
(111) 'A'	-	12-215	1X521	Flight	24-00-00	24-51-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
avionics load shed contactor				compartment LH racking	R/I	
(112) 'B' avionics load shed contactor	-	12-216	2X521	Flight compartment RH racking	24-00-00 R/I	24-51-07
(113) AVIONIC LOAD SHED 'A' SYS SUP circuit breaker 115 V	-	21-215	1X520	Flight compartment LH racking	24-50-00 R/I	24-51-31
(114) AVIONIC LOAD SHED 'B' SYS SUP circuit breaker 115 V	-	21-216	2X520	Flight compartment RH racking	24-50-00 R/I	24-51-31
(115) Circuit breaker 115 V	-	2-213	X137	Map ref.B22	24-50-00 R/I	24-24-01
(116) Static inverter control relay	-	19-215	X139	Flight compartment LH racking	24-24-00 R/I	24-24-01
(117) Ram air turbine (RAT) control switch	-	14-214	M763	3CM station	29-00-00 R/I	29-24-01
(118) Ram air turbine (RAT) control switch	-	14-214	M764	3CM station	29-00-00 R/I	29-24-01
(119) 26 V a.c. transformer	-	18-215	X135	Flight compartment LH racking	24-24-11 R/I	24-24-01
(120) Circuit breaker 115 V	-	1-213	X138	Map ref.N10	24-50-00 R/I	24-24-01
(121) Static inverter	-	9-215	X140	Flight compartment LH racking	24-24-12 R/I	24-24-01

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(122) 'A' system essential/main split contactor	-	12-215	1P9	Flight compartment LH racking	24-00-00 R/I	24-52-04
(123) 'B' system essential/main split contactor	-	12-216	2P9	Flight compartment RH racking	24-00-00 R/I	24-52-04
(124) 'A' system main d.c. undervolt unit	-	12-215	1P15	Flight compartment LH racking	24-52-11 R/I	24-52-04
(125) 'B' system main d.c. undervolt unit	-	12-216	2P15	Flight compartment RH racking	24-52-11 R/I	24-52-04
(126) Fuse	-	12-215	1P11	Flight compartment LH racking	24-00-00 R/I	24-31-01
(127) Fuse	-	12-216	2P11	Flight compartment RH racking	24-00-00 R/I	24-31-02
(128) No.1 control and protection unit (CPU)	-	2-215	1X3	Flight compartment LH racking	24-21-21 R/I	24-21-02
(129) No.2 control and protection unit (CPU)	-	1-215	2X3	Flight compartment LH racking	24-21-21 R/I	24-21-02
(130) No.3 control and protection unit (CPU)	-	1-216	3X3	Flight compartment RH racking	24-21-21 R/I	24-21-02
(131) No.4 control and	-	2-216	4X3	Flight compartment	24-21-21 R/I	24-21-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
protection unit (CPU)				RH racking		
(132) No.1 essential neon indicator lamp	-	2-213	1X136	Inside face of CB panel 2-213	24-50-00 R/I	24-51-06
(133) No.2 essential neon indicator lamp	-	2-213	2X136	Inside face of CB panel 2-213	24-50-00 R/I	24-51-06
(134) No.3 essential neon indicator lamp	-	4-213	3X136	Inside face of CB panel 4-213	24-50-00 R/I	24-51-07
(135) No.4 essential neon indicator lamp	-	4-213	4X136	Inside face of CB panel 4-213	24-50-00 R/I	24-51-07
(136) Circuit breaker 115/200 V	-	2-213	1X124	Map ref.C23	24-50-00 R/I	24-51-06
(137) Circuit breaker 115/200 V	-	2-213	2X124	Map ref.D23	24-50-00 R/I	24-51-06
(138) Circuit breaker 115/200 V	-	4-213	3X124	Map ref.A14	24-50-00 R/I	24-51-07
(139) Circuit breaker 115/200 V	-	4-213	4X124	Map ref.D14	24-50-00 R/I	24-51-07
(140) No.1 RELT NORM SUP circuit breaker 115/200 V	-	22-215	1X226	Flight compartment LH racking	24-50-00 R/I	24-51-06
(141) No.2 RELT NORM SUP circuit breaker 115/200 V	-	21-215	2X226	Flight compartment LH racking	29-50-00 R/I	24-51-06

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(142) No.3 RELT NORM SUP circuit breaker 115/200 V	-	21-216	3X226	Flight compartment RH racking	24-50-00 R/I	24-51-07
(143) No.4 RELT NORM SUP circuit breaker 115/200 V	-	22-216	4X226	Flight compartment RH racking	24-50-00 R/I	24-51-07
(144) Emergency generator neon indicator lamp	-	12-215	X232	Flight compartment LH racking	24-00-00 R/I	24-22-02
(145) Circuit breaker 28 V	-	1-213	1X230	Map ref.R10	24-50-00 R/I	24-22-01
(146) Circuit breaker 28 V	-	3-213	4X230	Map ref.H8	24-50-00 R/I	24-51-07
(147) No.1 relight change-over contactor	-	12-215	1X228	Flight compartment LH racking	24-00-00 R/I	24-51-06
(148) No.2 relight change-over contactor	-	12-215	2X228	Flight compartment LH racking	24-00-00 R/I	24-51-06
(149) No.3 relight change-over contactor	-	12-215	3X228	Flight compartment LH racking	24-00-00 R/I	24-51-07
(150) No.4 relight change-over contactor	-	12-215	4X228	Flight compartment LH racking	24-00-00 R/I	24-51-07
(151) EMERG RELIGHT BUSBAR selector switch	-	18-214	X229	3CM station	24-22-00 R/I	24-51-06
(152) Emergency generator hydraulic selector valve	153 DB	153	X206	Below floor of rear baggage compartment	24-12-12 R/I	24-22-01

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(153) No.1 engine relight neon indicator lamp	-	12-215	1X233	Flight compartment LH racking	24-00-00 R/I	24-51-06
(154) No.2 engine relight neon indicator lamp	-	12-215	2X233	Flight compartment LH racking	24-00-00 R/I	24-51-06
(155) No.3 engine relight neon indicator lamp	-	12-215	3X233	Flight compartment LH racking	24-00-00 R/I	24-51-07
(156) No.4 engine relight neon indicator lamp	-	12-215	4X233	Flight compartment LH racking	24-00-00 R/I	24-51-07
(157) RELIGHT BAR Nos.1 & 4 EMERG SUPPLY circuit breaker 115/200 V	-	23-215	1X227	Flight compartment LH racking	24-50-00 R/I	24-51-07
(158) RELIGHT BAR Nos.2 & 3 EMERG SUPPLY circuit breaker 115/200 V	-	23-215	3X227	Flight compartment LH racking	24-50-00 R/I	24-51-07
(159) VOLTS/ FREQ IND circuit breaker 115 V	-	23-215	D111	Flight compartment LH racking	24-50-00 R/I	24-21-81
(160) Circuit breaker 115 V	-	2-213	X134	Map ref.C18	24-50-00 R/I	24-24-01
(161) AC FREQ/ VOLTS selector switch	-	6-214	D115	3CM station	24-00-00 R/I	24-21-81
(162) Emergency	153 DB	153	X200	Below floor	24-12-11	24-22-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
generator and drive unit	and 153 EB			of rear baggage compartment	R/I	
(163) Differ- ential protect- ion current transformer	-	12-215	X202	Flight compartment LH racking	24-22-12 R/I	24-22-02
(164) Engine pulse probe unit	-	400	E243	Engine accessory gearbox	76-12-02 R/I	77-11-04
(165) No.1 GEN KW/VAR METER SUP circuit breaker	-	22-215	1X280	Flight compartment LH racking	24-50-00 R/I	24-21-81
(166) No.2 GEN KW/VAR METER SUP circuit breaker	-	21-215	2X280	Flight compartment LH racking	24-50-00 R/I	24-21-81
(167) No.3 GEN KW/VAR METER SUP circuit breaker	-	21-216	3X280	Flight compartment RH racking	24-50-00 R/I	24-21-81
(168) No.4 GEN KW/VAR METER SUP circuit breaker	-	22-216	4X280	Flight compartment RH racking	24-50-00 R/I	24-21-81
(169) No.1 GCB position magnetic indicator	-	3-214	1X8	3CM station	24-00-00 R/I	24-21-02
(170) No.2 GCB position magnetic indicator	-	3-214	2X8	3CM station	24-00-00 R/I	24-21-02
(171) No.3 GCB position	-	3-214	3X8	3CM station	24-00-00 R/I	24-21-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
magnetic indicator						
(172) No.4 GCB position magnetic indicator	-	3-214	4X8	3CM station	24-00-00 R/I	24-21-02
(173) GEN 1 caption light module	-	3-214	1X13	3CM station	24-00-00 R/I	24-21-02
(174) GEN 2 caption light module	-	3-214	2X13	3CM station	24-00-00 R/I	24-21-02
(175) GEN 3 caption light module	-	3-214	3X13	3CM station	24-00-00 R/I	24-21-02
(176) GEN 4 caption light module	-	3-214	4X13	3CM station	24-00-00 R/I	24-21-02
(177) No.1 generator circuit breaker (GCB)	-	24-215	1X5	Flight compartment LH racking	24-00-00 R/I	24-21-02
(178) No.2 generator circuit breaker (GCB)	-	24-215	2X5	Flight compartment LH racking	24-00-00 R/I	24-21-02
(179) No.3 generator circuit breaker (GCB)	-	24-216	3X5	Flight compartment RH racking	24-00-00 R/I	24-21-02
(180) No.4 generator circuit breaker (GCB)	-	24-216	4X5	Flight compartment RH racking	24-00-00 R/I	24-21-02
(181) Circuit	-	1-213	1X12	Map ref.P9	24-50-00	24-21-02

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
breaker 28 V					R/I	
(182) Circuit breaker 28 V	-	3-213	4X12	Map ref.E10	24-50-00 R/I	24-21-02
(183) No.1 generator control switch	-	3-214	1X7	3CM station	24-00-00 R/I	24-21-02
(184) No.2 generator control switch	-	3-214	2X7	3CM station	24-00-00 R/I	24-21-02
(185) No.3 generator control switch	-	3-214	3X7	3CM station	24-00-00 R/I	24-21-02
(186) No.4 generator control switch	-	3-214	4X7	3CM station	24-00-00 R/I	24-21-02
(187) Circuit breaker 28 V	-	1-213	1X310	Map ref.R7	24-50-00 R/I	24-11-01
(188) Circuit breaker 28 V	-	1-213	2X310	Map ref.R8	24-50-00 R/I	24-11-02
(189) Circuit breaker 28 V	-	3-213	3X310	Map ref.G8	24-50-00 R/I	24-11-03
(190) Circuit breaker 28 V	-	3-213	4X310	Map ref.G9	24-50-00 R/I	24-11-04
(191) No.1 IDG oil low pressure warning switch	-	415	-	Part of integrated drive generator	24-11-11 R/I	24-11-01
(192) No.2 IDG oil low pressure warning switch	-	426	-	Part of integrated drive generator	24-11-11 R/I	24-11-02
(193) No.3 IDG oil low	-	435	-	Part of integrated	24-11-11 R/I	24-11-03

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
pressure warning switch				drive generator		
(194) No.4 IDG oil low pressure warning switch	-	446	-	Part of integrated drive generator	24-11-11 R/I	24-11-04
(195) CSD 1 caption light module	-	3-214	1X312	3CM station	24-00-00 R/I	24-11-01
(196) CSD 2 caption light module	-	3-214	2X312	3CM station	24-00-00 R/I	24-11-02
(197) CSD 3 caption light module	-	3-214	3X312	3CM station	24-00-00 R/I	24-11-03
(198) CSD 4 caption light module	-	3-214	4X312	3CM station	24-00-00 R/I	24-11-04
(199) No.1 integrated drive generator (IDG)	-	415	1X1	No.1 engine RH access-ory gearbox	24-11-11	24-21-02
(200) No.2 integrated drive generator (IDG)	-	426	2X1	No.2 engine RH access-ory gearbox	24-11-11 R/I	24-21-02
(201) No.3 integrated drive generator (IDG)	-	435	3X1	No.3 engine RH access-ory gearbox	24-11-11 R/I	24-21-02
(202) No.4 integrated drive generator (IDG)	-	446	4X1	No.4 engine RH access-ory gearbox	24-11-11 R/I	24-21-02
(203) Ground	-	24-216	X21	Flight	24-00-00	24-41-01

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
power breaker (GPB)				compartment RH racking	R/I	
(204) No.1 differential protection current transformer unit	-	24-215	1X2	Flight compartment LH racking	24-21-12 R/I	24-21-02
(205) No.2 differential protection current transformer unit	-	24-215	2X2	Flight compartment LH racking	24-21-12 R/I	24-21-02
(206) No.3 differential protection current transformer unit	-	24-216	3X2	Flight compartment RH racking	24-21-12 R/I	24-21-02
(207) No.4 differential protection current transformer unit	-	24-216	4X2	Flight compartment RH racking	24-21-12 R/I	24-21-02
(208) No.1 load controller	-	2-215	1X314	Flight compartment LH racking	24-11-21 R/I	24-11-01
(209) No.2 load controller	-	1-215	2X314	Flight compartment LH racking	24-11-21 R/I	24-11-02
(210) No.3 load controller	-	1-216	3X314	Flight compartment RH racking	24-11-21 R/I	24-11-03
(211) No.4 load controller	-	2-216	4X314	Flight compartment	24-11-21 R/I	24-11-04

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
				RH racking		
(212) No.1 KW/ KVAR meter	-	3-214	1X282	3CM station	24-00-00 R/I	24-21-91
(213) No.2 KW/ KVAR meter	-	3-214	2X282	3CM station	24-00-00 R/I	24-21-91
(214) No.3 KW/ KVAR meter	-	3-214	3X282	3CM station	24-00-00 R/I	24-21-91
(215) No.4 KW/ KVAR meter	-	3-214	4X282	3CM station	24-00-00 R/I	24-21-91
(216) No.1 KW/ KVAR meter resistor	-	12-215	1X283	Flight compartment LH racking	24-00-00 R/I	24-21-91
(217) No.2 KW/ KVAR meter resistor	-	12-215	2X283	Flight compartment LH racking	24-00-00 R/I	24-21-91
(218) No.3 KW/ KVAR meter resistor	-	12-216	3X283	Flight compartment RH racking	24-00-00 R/I	24-21-91
(219) No.4 KW/ KVAR meter resistor	-	12-216	4X283	Flight compartment RH racking	24-00-00 R/I	24-21-91
(220) No.1 KW/ KVAR meter current transformer	-	24-215	1X284	Flight compartment LH racking	24-00-00 R/I	24-21-91
(221) No.2 KW/ KVAR meter current transformer	-	24-215	2X284	Flight compartment LH racking	24-00-00 R/I	24-21-91
(222) No.3 KW/ KVAR meter current transformer	-	24-216	3X284	Flight compartment RH racking	24-00-00 R/I	24-21-91

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
(223) No.4 KW/ KVAR meter current transformer	-	24-216	4X284	Flight compartment RH racking	24-00-00 R/I	24-21-91
(224) Nos.1 & 2 KW/KVAR meters c/o relay	-	12-215	1X285	Flight compartment LH racking	24-00-00 R/I	24-21-91
(225) Nos.3 & 4 KW/KVAR meters c/o relay	-	12-216	4X285	Flight compartment RH racking	24-00-00 R/I	24-21-91
(226) PUSH FOR KVAR switch	-	3-214	X286	3CM station	24-00-00 R/I	24-21-91
(227) Emergency generator KVA meter current transformer	-	12-215	X203	Flight compartment RH racking	24-00-00 R/I	24-22-02
(228) Circuit breaker 28 V	-	15-215	X281	Flight compartment LH racking	24-50-00 R/I	24-21-91
(229) Circuit breaker 28 V	-	15-215	1P13	Flight compartment LH racking	24-50-00 R/I	24-52-04
(230) Circuit breaker 28 V	-	15-216	2P13	Flight compartment LH racking	24-50-00 R/I	24-52-04
(231) Diode	-	6-214	X234	3CM station	24-00-00 R/I	24-22-02
(232) Override relay	-	12-215	X235	Flight compartment LH racking	24-00-00 R/I	24-22-01

Component Identification
Table 103

1. General

When servicing or testing electrical systems, implement the following electrical safety precautions in addition to observing the WARNINGS and CAUTIONS given for specific procedures.

2. Electrical Safety Precautions

WARNING: DEATH COULD RESULT FROM AN ELECTRIC SHOCK RECEIVED FROM A 200/115 V SYSTEM.

A. Protection of Personnel and Equipment

(1) Before work is commenced on any electrical or electronic systems or equipment, or in proximity to unshielded electrical terminals or equipment, the associated circuits must be effectively isolated unless specifically required to be 'live' for tests or adjustments.

(2) When tests or adjustments necessitate work on a system that is 'live', or require the use of electrical test equipment using local or self-generated power supplies, adequate precautions must be taken to ensure the safety of personnel and to obviate the risk of fire, explosion or damage.

(3) Before power supplies are connected or reconnected to any circuit or system, the operative must ensure that no danger exists to personnel, the aircraft and equipment and that suitable precautions are taken against the premature connection of power supplies to a circuit or system.

(4) When wiring is disconnected, cable terminations must be secured and protected as necessary to ensure electrical isolation; suitable blanks must be fitted to electrical connectors.

B. Isolation of Electrical Generation and External Power Supplies

(1) Certain conditions require the isolation of all aircraft-generated and external power supplies from the aircraft, e.g., where equipment cannot be completely isolated from electrical power supplies by the tripping of circuit breakers or the removal of fuses. When such electrical isolation is

R necessary, the following precautions must be taken
R to prevent power supplies from being connected to
R the associated system or systems.

R (a) The aircraft engines and emergency generator must not be run.

(b) External power must not be connected to the aircraft.

(c) Both battery control switches must be set to the
R 'off' position. This will isolate the aircraft
R batteries from all but the directly connected
R battery busbars. If complete isolation of the
R d.c. system is required, the batteries must be
R disconnected.

(d) Warning notices must be placed in suitable positions to inform personnel of these requirements.

GENERAL - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

R CAUTION: WHEN MOVING HEAVY DUTY CABLES DURING MAINTENANCE MAKE
R CERTAIN THAT ADEQUATE CLEARANCE, "LAY" AND CLAMPING IS
R RETAINED AND AVOID STRAIN AT TERMINALS.

1. General

A. Introduction

This topic contains general instructions for the removal and installation of smaller electrical components, fitted to panels and equipment racks, that are common to sub-systems within Chapter 24. Panels and equipment racks and their associated smaller electrical components are as follows:-

(1) Electrical generating control panel (upper) (3-214):

Switches, caption light modules, magnetic indicators, oil temperature indicators and KW/KVAR meters.

**ON A/C 007-007,

(2) Electrical generating control panel (lower) (6-214):

Switches, caption light modules, magnetic indicators, diodes, voltmeters, ammeters and a frequency meter.

**ON A/C 001-006,

(2) Electrical generating control panel (lower) (6-214):

Switches, caption light modules, magnetic indicators, voltmeters, ammeters and a frequency meter.

(3) Flight compartment LH racking, shelf 12-215:

Contactors, relays, transformers, neon indicators, resistors, fuses, meter shunts and a diode.

(4) Flight compartment RH racking, shelf 12-216:

Contactors, relays, neon indicators, resistors and fuses.

(5) Flight compartment LH racking, panel 24-215:

Split system breaker (SSB), bus-tie breakers (BTBs), generator circuit breakers (GCBs), transformers and neon indicators.

(6) Flight compartment RH racking, panel 24-216:

Split system breaker (SSB), bus-tie breakers (BTBs), generator circuit breakers (GCBs), transformers, neon indicators and a ground power breaker (GPB).

(7) Oxygen panel, 20-215:

Ground lighting control switch (for removal and installation procedures, refer to 33-10-00).

R **ON A/C 007-007,

B. Upper and Lower Electrical Generating Control Panels (Ref. Fig.401 and 402)

NOTE: Reference should be made to Table 401 for the key to Figure 401, and to Table 402 for the key to Figure 402.

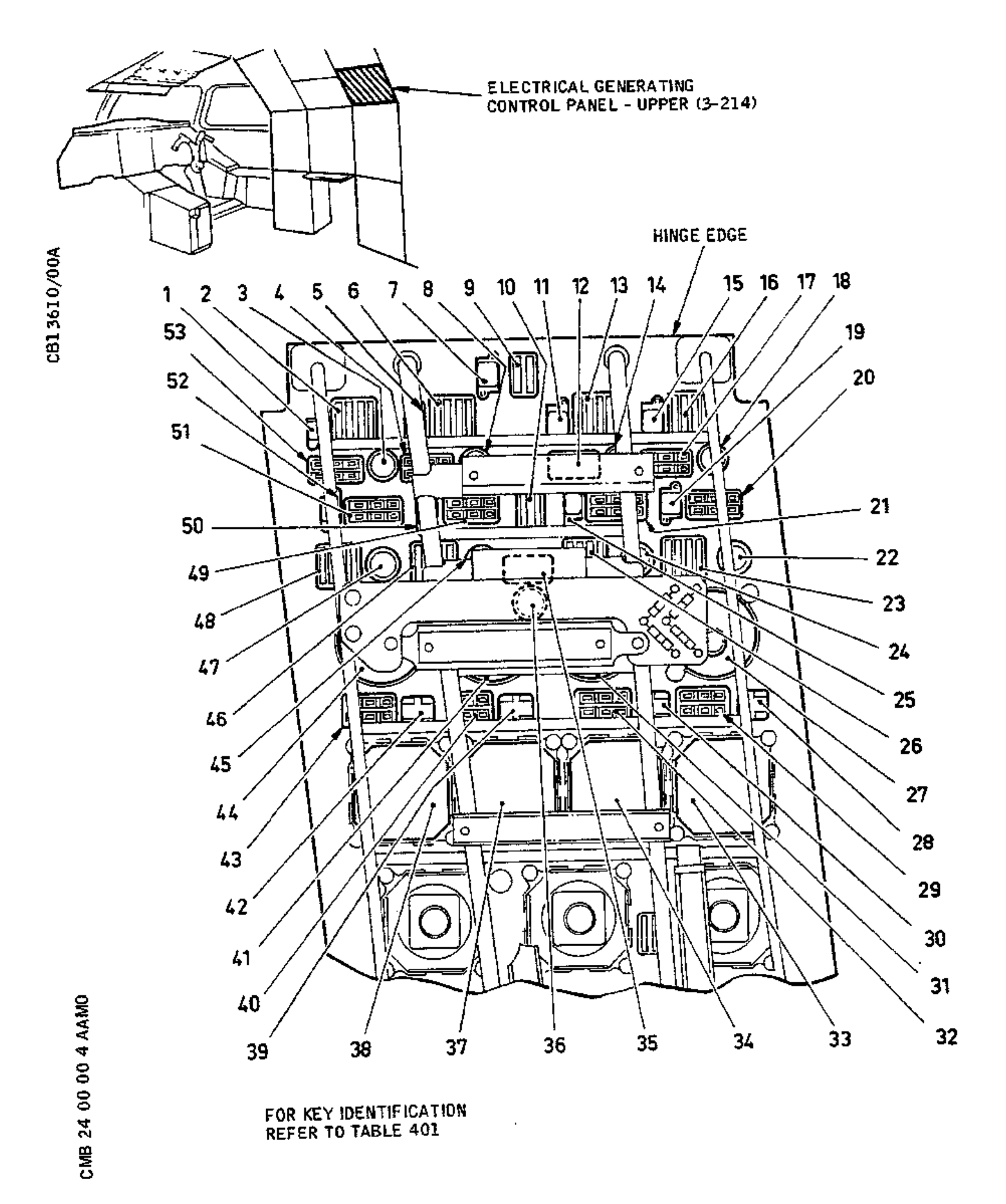
Switches, magnetic indicators and diodes are mounted from the rear of the appropriate panel, access being gained by lowering the panel on its hinges. Caption light modules and meters are mounted from the front of the panel and clamped to the panel at the rear. The meters are secured by instrument clamps that are released by adjusting screws mounted on the front of the panel, close to the associated meter. Diodes have soldered connections to barb insulators mounted on diode boards behind the panel.

R **ON A/C 001-006,

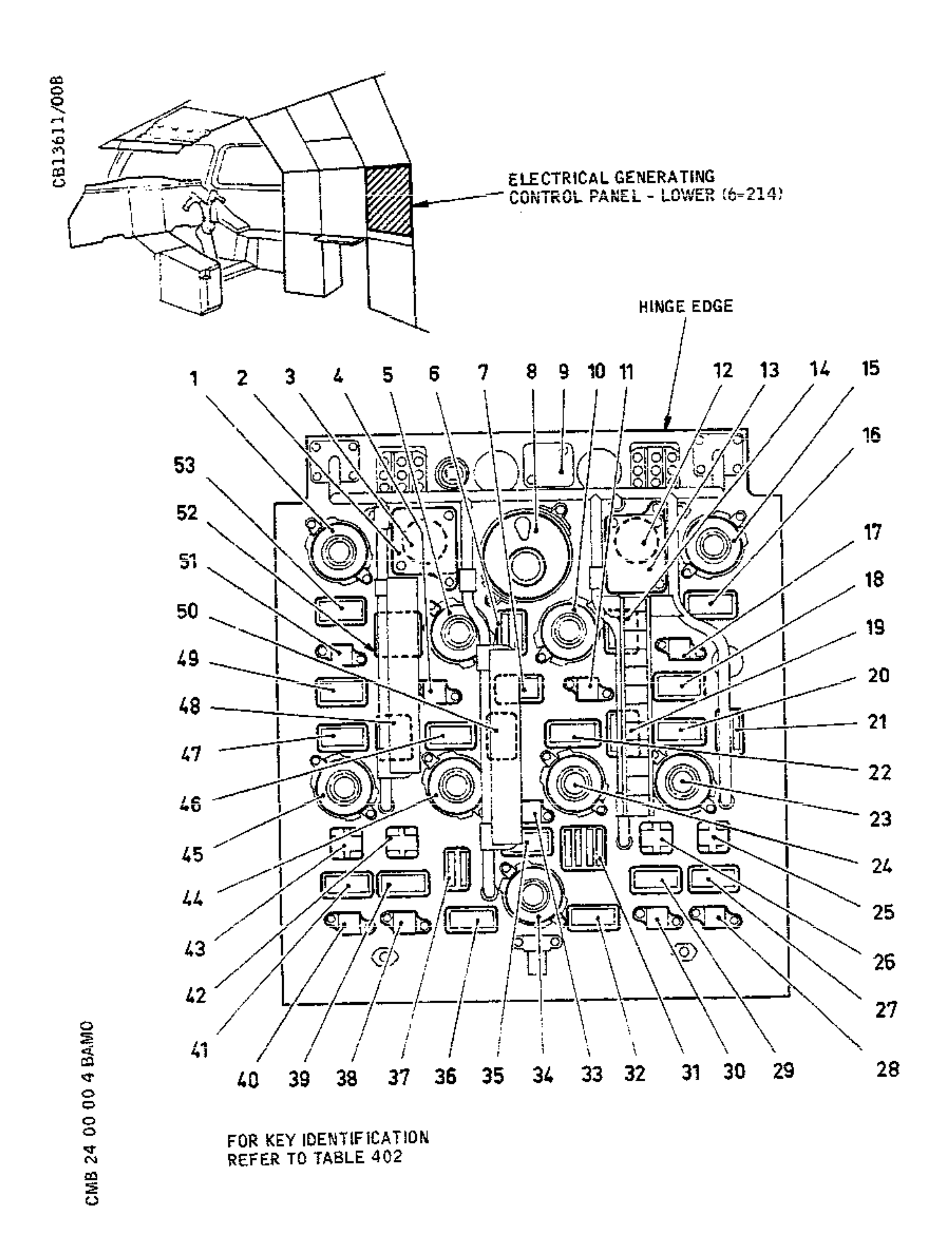
B. Upper and Lower Electrical Generating Control Panels (Ref. Fig.401 and 403)

NOTE: Reference should be made to Table 401 for key to Figure 401, and to Table 402 for key to Figure 402.

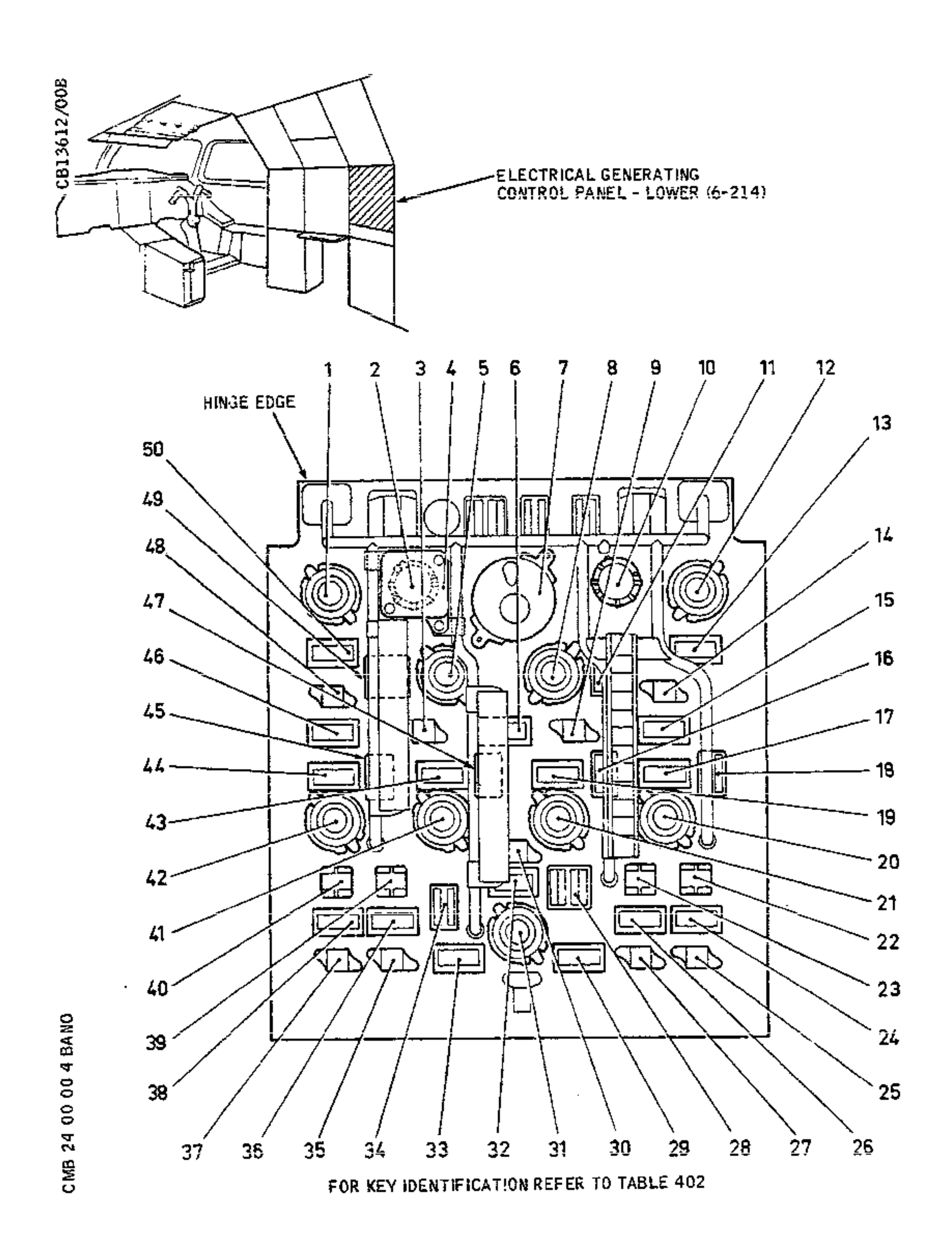
Switches, magnetic indicators and a diode are mounted from the rear of the appropriate panel, access being gained by lowering the panel on its hinges. Caption light modules and meters are mounted from the front of the panel and clamped to the panel at the rear. The meters are secured by instrument clamps that are released by adjusting screws mounted on the front of the panel, close to the associated meter. The diode has soldered connections to barb insulators mounted on a diode board behind the panel.



- Electrical Generating Control Panel (Upper) -
Diagrammatic Rear View
Figure 401



- Electrical Generating Control Panel (Lower) -
Diagrammatic Rear View
Figure 402



- Electrical Generating Control Panel (Lower) -
Diagrammatic Rear View
Figure 403

Cable formers, which act as panel strengthening supports on the rear of each panel, support cable looms and terminal blocks which may restrict access to components, terminals or connectors. These cable looms and terminal blocks may be temporarily moved to facilitate access to electrical components. To remove and install a magnetic indicator, it is necessary to withdraw the associated electroluminescent panel (Ref. 33-16-00) sufficiently to gain access to the magnetic indicator securing screws.

Electrical connections to toggle switches, push-switches, caption light modules and magnetic indicators are made to screw-type or socket-type terminals, and to rotary switches by flying leads.

Each KW/KVAR meter and its associated resistor are matched, therefore both components should be fitted as a pair.

C. Flight Compartment Racking (Ref. Fig. 404, 405 and 406)

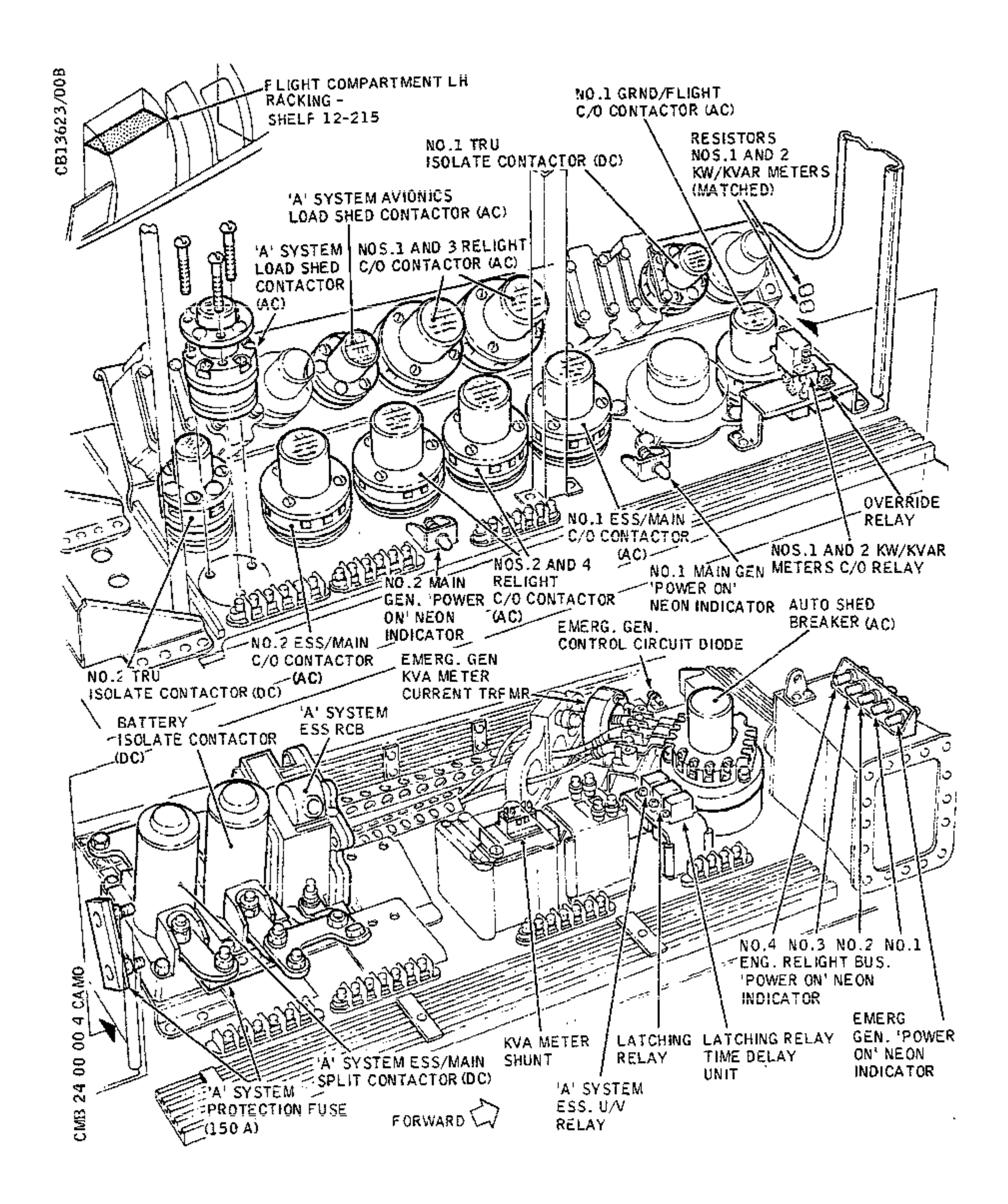
Electrical equipment associated with Nos.1 and 2 main a.c. generation systems, emergency generation, d.c. distribution sub-system 'A', engine relight and ground power control is mounted in the flight compartment LH racking on shelf 12-215.

Electrical equipment associated with Nos.3 and 4 main a.c. generation systems, d.c. distribution sub-system 'B' and ground power control is mounted in the flight compartment RH racking on shelf 12-216. The components are fitted behind hinged circuit breaker panels mounted on the appropriate racking upper structure.

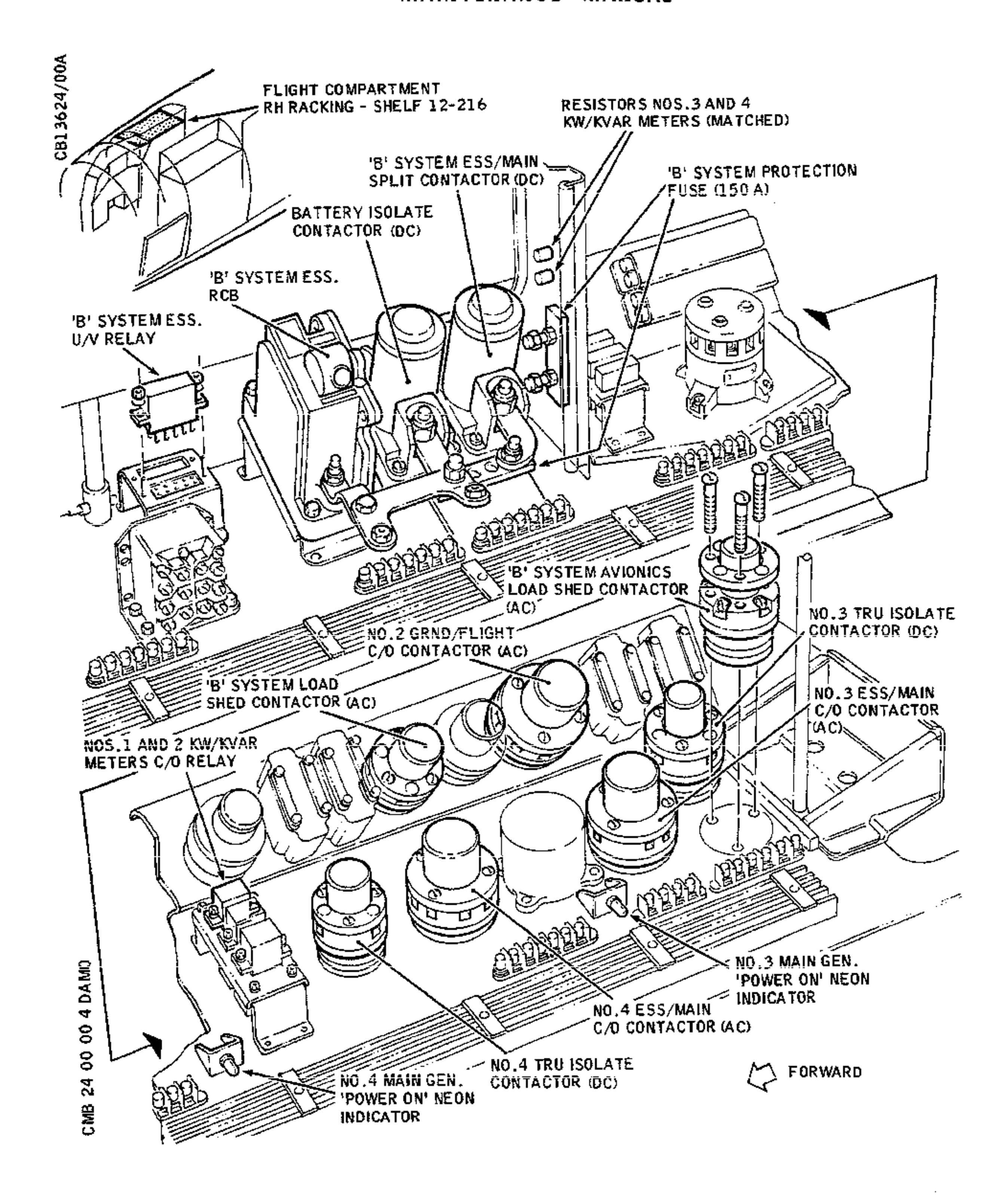
Neon warning 'power on' indicators associated with Nos. 1, 2, 3 and 4 engine relight and emergency generation, glow when the appropriate busbars are energized.

GCBs, BTBs, SSBs and KW/KVAR meter current transformers are secured on the aft end of the flight compartment LH racking on panel 24-215 (Nos.1 and 2), and on the aft end of the RH racking on panel 24-216 (Nos.3 and 4). The GPB is also fitted on panel 24-216. Neon warning 'power on' indicators, centrally mounted on each panel, indicate when the appropriate main a.c. busbars are energized.

The panel giving access to components on panel 24-215 is located behind the service trolley stowage under the



- Flight Compartment LH Racking (Shelf 12-215) -
Components
Figure 404



- Flight Compartment RH Racking (Shelf 12-216) -
Components
Figure 405

galley working surface, and may necessitate the dismantling of the galley structure for component removal.

R The panel giving access to components on panel 24-216 is located behind furnishing equipment which must be removed before component removal.

**ON A/C 007-007,

2. Components on Upper and Lower Electrical Generating Control Panels (Ref. Fig. 401, 402 and 407)
(Ref. Fig. 408)

**ON A/C 001-006,

2. Components on Upper and Lower Electrical Generating Control Panels (Ref. Fig. 401, 403 and 407)
(Ref. Fig. 408)

CAUTION: WHEN ELECTRICAL COMPONENTS ARE BEING INSTALLED, THE TORQUE LOADING OF TERMINAL SECURING DEVICES FOR CERTAIN COMPONENTS MUST BE CARRIED OUT IN ACCORDANCE WITH 20-27-14.

ELECTROLUMINESCENT (EL) PANELS ARE VULNERABLE TO DAMAGE BY SCRATCHING AND CRACKING. ENSURE THAT TOOLS USED IN THE FOLLOWING OPERATIONS DO NOT DAMAGE THE POLISHED WALLS OF THE PANELS.

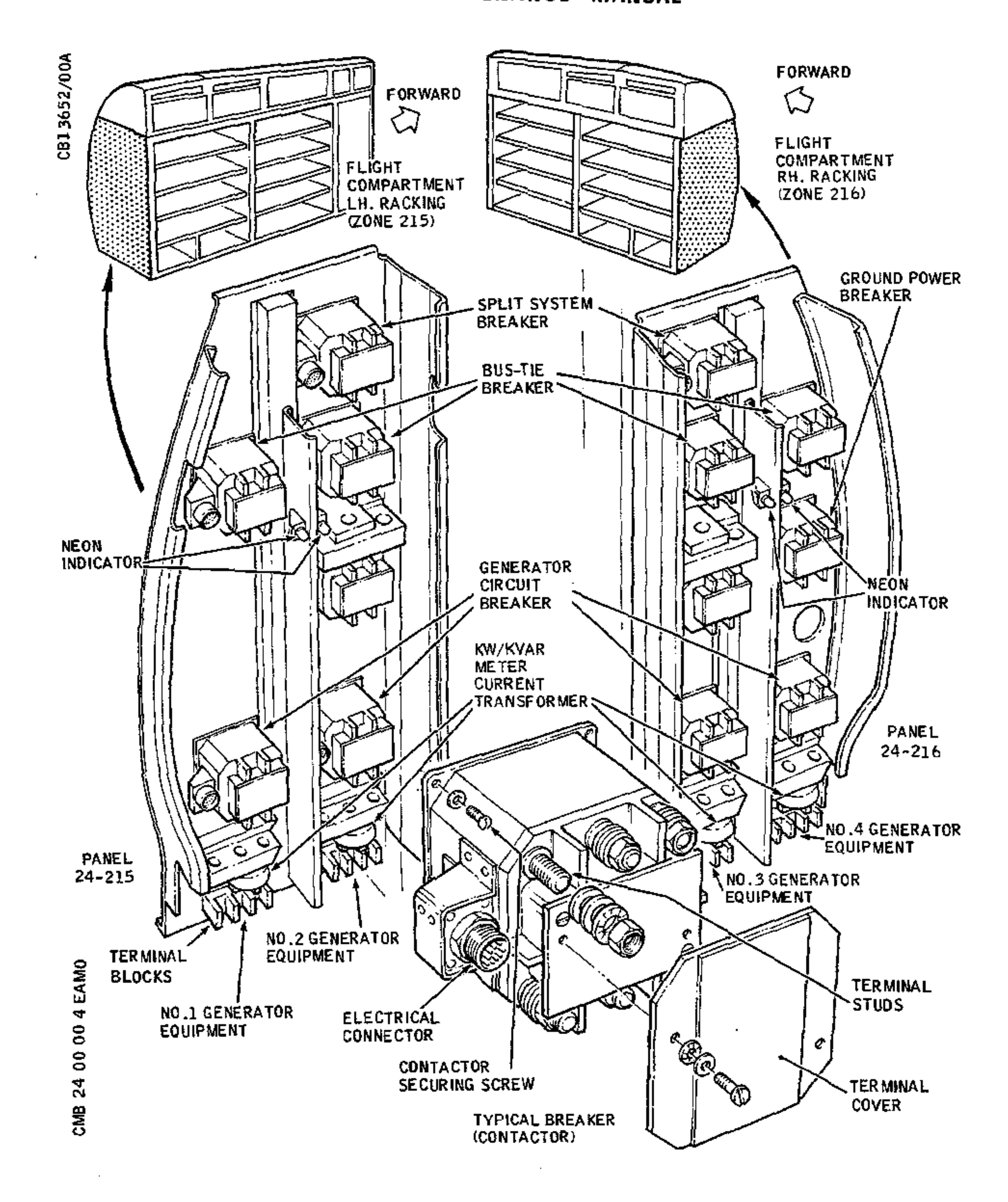
A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 5 to 8 lbf in (0.0565 to 0.0904 mdaN)	-

B. Prepare

NOTE: On electrical components with socket-type terminals, the pin inserts must be disconnected and connected in accordance with the Wiring Diagram Manual, 20-42-18.

(1) For components on the upper electrical generating control panels, isolate the electrical generation and external power supplies as detailed in



- Flight Compartment LH and RH Racking, Panels 24-215 and 24-216 - Components
Figure 406

24-00-00, Servicing.

(2) For components on the lower electrical generating control panel, isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing. In addition trip the BATT A CONTROL circuit breaker 1P24, on panel 16-215, and the BATT B CONTROL circuit breaker 2P24, on panel 16-216, and fit safety clips.

(3) At the appropriate panel, release the quick-release fasteners, press in the spring retaining clip and lower the panel on its hinges.

NOTE: Reference should be made to Table 401 for the key to Figure 401, and to Table 402 for the key to Figure 402.

C. Remove Toggle Switch or Push-switch

(1) On a switch with screw-type terminals, roll back the rubber terminal cover and disconnect the electrical cables from the switch. On a switch with socket-type terminals, withdraw the pin inserts from the rear of the switch.

(2) Where necessary, unscrew the push-switch knob and, if fitted, remove the insulating sleeve from the switch plunger. Using a tubular spanner, remove the nut and washer from the front of the panel and remove the switch guard, if fitted. Withdraw the switch and tabwasher from the rear of the panel.

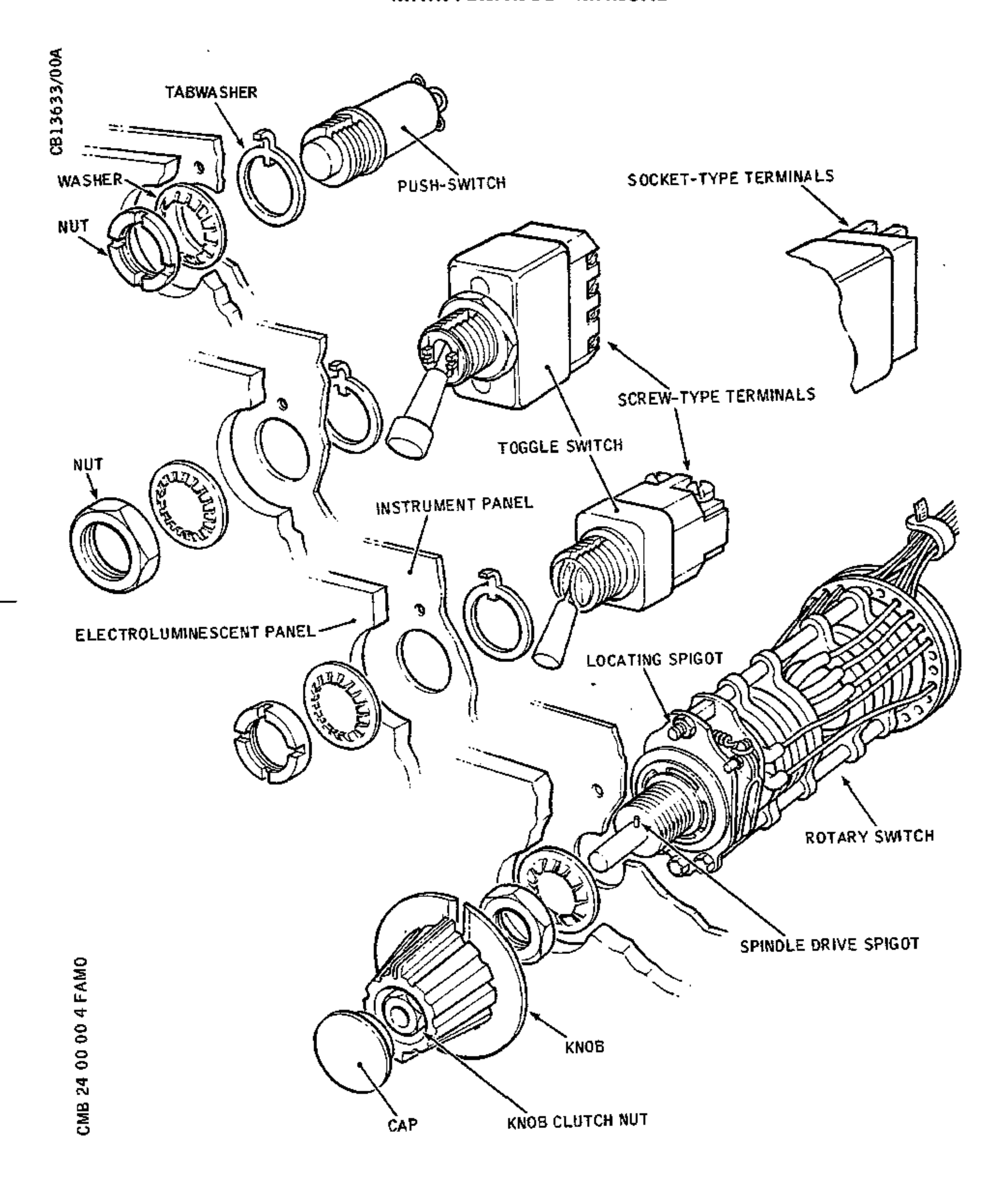
D. Install Toggle Switch or Push-switch

(1) Comply with the electrical safety precautions.

(2) Position the tabwasher on the switch and insert the switch through the aperture from the rear of the panel, ensuring that the tab on the tabwasher engages the locating hole in the panel.

(3) If applicable, refit the guard to the switch, and secure the switch with the nut and washer. Where necessary, refit the push-switch knob; if applicable, fit the insulating sleeve to the switch plunger before refitting the switch knob.

(4) Connect the electrical cables to the switch, ensuring that the connections are made in accordance with the cable identifications and



Switches - Installation
Figure 407

the applicable wiring diagram. Position the rubber terminal cover over the screw-type terminals.

E. Remove Rotary Switch

(1) Release the flying leads from the loom ties and withdraw the pin inserts from the module block.

(2) Remove the cap from the end of the switch knob, loosen the clutch nut and withdraw the knob from the switch spindle.

(3) Using a tubular spanner, remove the nut and washer from the front of the panel and withdraw the switch from the rear.

F. Install Rotary Switch

(1) Comply with the electrical safety precautions.

(2) Insert the switch through the aperture from the rear of the panel, ensuring that the locating spigot engages the locating hole in the panel.

(3) Secure the switch with the nut and washer.

(4) Fit the knob on the switch spindle, ensuring that the spindle spigot is engaged with the slot in the knob. Tighten the clutch nut and fit the end cap.

(5) Connect the flying leads to the module block, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(6) Secure the flying leads to the cable loom with suitable ties in accordance with 20-27-15.

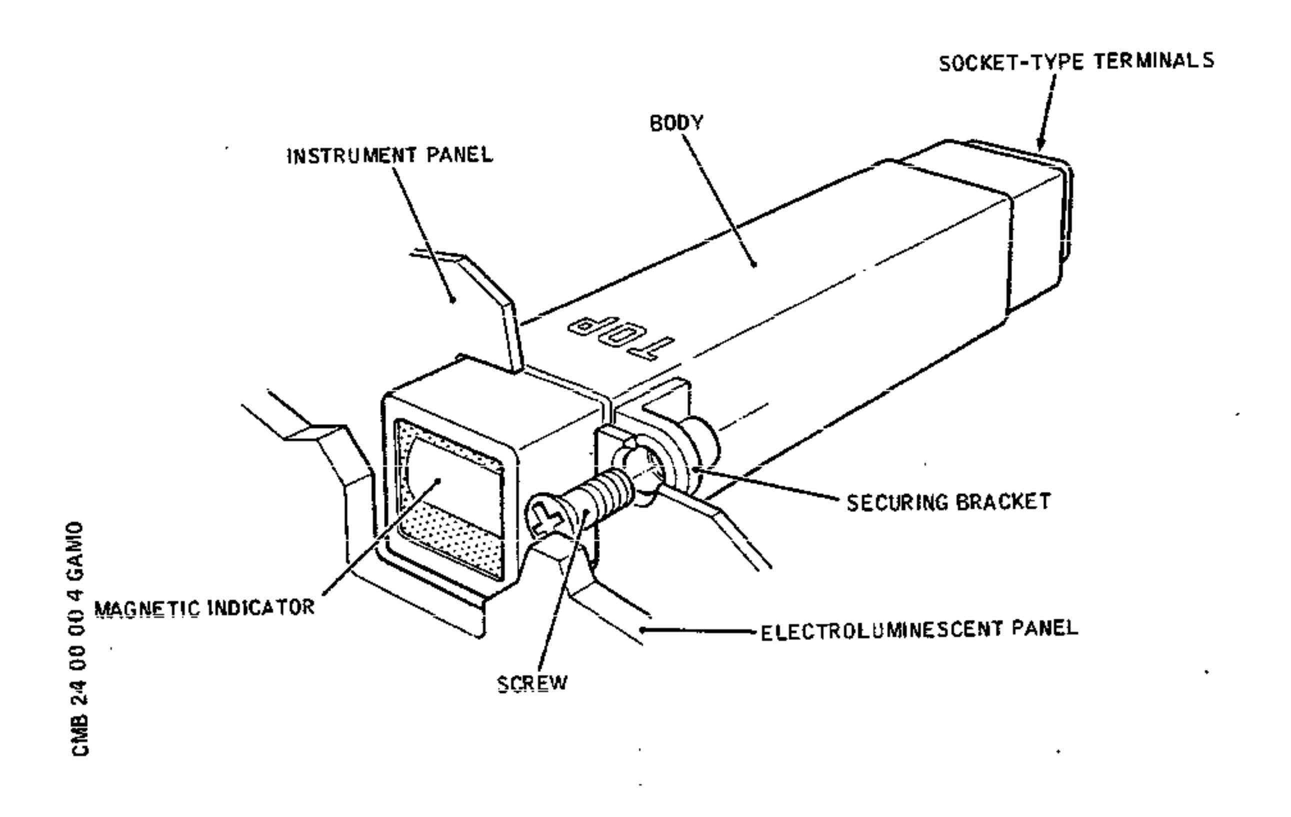
G. Remove Caption Light Module

(1) If necessary, release the cable loom ties to gain access to the terminals at the rear of the caption light module.

(2) Disconnect the electrical cables from the terminals. On modules with socket-type terminals, withdraw the pin inserts from the rear of the module.

CB1 3634/00A

SOCKET-TYPE TERMINALS
RETAINING SPRING
RECESS
MOUNTING PANEL
MODULE CLAMP
ELECTROLUMINESCENT PANEL
SOCKET-TYPE TERMINALS
HINGE
CAPTION LIGHT MODULE



Caption Light Modules and Magnetic Indicators - Installation
Figure 408

(3) Disengage the clamp retaining springs at the rear of the module, and withdraw the module from the front of the panel and clamp from the rear.

H. Install Caption Light Module

(1) Comply with the electrical safety precautions.

(2) Position the clamp on the rear of the panel and insert the caption light module through the aperture from the front, ensuring that the hinged edge of the module is in alignment with the white-painted line on the back of the panel, and that the clamp is aligned symmetrically with the module.

(3) Hold the module firmly against the front of the panel and press the clamp into position from the rear until the retaining springs engage the recesses in the module body.

(4) Connect the electrical cables to the module, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(5) Secure the cable loom ties, as necessary, in accordance with 20-27-15.

I. Remove Magnetic Indicator

(1) If necessary, release the cable loom ties to gain access to the terminals at the rear of the magnetic indicator.

(2) Withdraw the pin inserts from the rear of the indicator.

(3) Remove the associated electroluminescent (EL) panel (Ref. 33-16-00) sufficiently to gain access to the magnetic indicator securing screws.

(4) Remove the securing screws from the front of the panel and withdraw the magnetic indicator from the rear.

J. Install Magnetic Indicator

(1) Comply with the electrical safety precautions.

(2) Assemble the magnetic indicator to the panel from

the rear, ensuring that the word TOP on the body of the indicator is in alignment with the white-painted line at the back of the panel.

(3) Secure the indicator to the panel with the securing screws, from the front.

(4) Refit the EL panel to its mounting (Ref. 33-16-00).

(5) Connect the electrical cables to the indicator terminals, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(6) Secure the cable loom ties, as necessary, in accordance with 20-27-15.

K. Remove Meter

CAUTION: RENEWAL OF A KW/KVAR METER NECESSITATES THE RENEWAL OF THE MATCHED RESISTOR FITTED IN THE FLIGHT COMPARTMENT RACKING ON SHELF 12-215 or 12-216, AS APPROPRIATE.

(1) With the appropriate panel open, disconnect the electrical connector from the back of the meter.

(2) Close and secure the panel, temporarily.

(3) Release the instrument clamp by unscrewing the adjusting screw, or screws, as applicable, mounted on the front of the panel close to the appropriate meter.

(4) Withdraw the meter from the panel.

L. Install Meter

(1) Comply with the electrical safety precautions.

(2) With the panel closed, insert the meter into the panel aperture.

(3) Align the face of the meter correctly and torque-tighten the adjusting screw, or screws, as applicable, to between 5 and 8 lbf in (0.0565 and 0.0904 mdaN).

(4) Release the panel and lower it on its hinges.

(5) Connect the electrical connector to the indicator,

ensuring that the mating surfaces are clean and undamaged.

M. Remove Diode

(1) Remove the screws securing the associated diode board cover to the diode board and remove the cover.

(2) Unsolder the diode wire ends from the barbs and remove the diode from the board.

N. Install Diode

(1) Comply with the electrical safety precautions.

(2) Position the replacement diode so that the cathode end, marked by a black ring, is orientated to ensure correct connection of the diode in accordance with the associated cable identifications and the applicable wiring diagram. Solder the wire ends to the associated barbs in accordance with the Wiring Diagram Manual, 20-42-23.

(3) Refit the diode board cover and secure it with the screws.

O. Conclusion

(1) Close the appropriate panel and secure it with the quick-release fasteners.

(2) Cancel the electrical safety precautions and check the operation of the component by carrying out the appropriate test procedure.

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (UPPER)	EQUIP. IDENT.
1	Indicator - magnetic, No.1 BTB position	1X10
2	Switch - toggle, with guard, No.1 BTB control	1X9
3	Switch - push, No.1 paralleling indicator	1X11
4	Caption light module - No.2 AC MAIN BUS	2X16
5	Indicator - magnetic, No.2 BTB position	2X10

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (UPPER)	EQUIP. IDENT.
6	Switch - toggle, with guard, No.2 BTB control	2X9
7	Indicator - magnetic, SSB position	X27
8	Switch - push, No.2 paralleling indicator	2X11
9	Switch - toggle, SSB control	X26
10	Switch - toggle, ground power control	X22
11	Indicator - magnetic, No.3 BTB position	3X10
12	Caption light module - No.3 AC MAIN BUS, No.3 main U/V warning	3X16
13	Switch - toggle, with guard, No.3 BTB control	3X9
14	Switch - push, No.3 paralleling indicator	3X11
15	Indicator - magnetic, No.4 BTB position	4X10
16	Switch - toggle, with guard, No.4 BTB control	4X9
17	Caption light module - No.4 AC MAIN BUS, No.4 main U/V warning	4X16
18	Switch - push, No.4 paralleling indicator	4X11
19	Indicator - magnetic, No.4 GCB position	4X8
20	Caption light module - GEN 4, No.4 generator failure warning	4X13
21	Caption light module - GEN 3, No.3 generator failure warning	3X13
22	Switch - push, No.4 IDG parallel assist	4X313
23	Switch - toggle, No.4 generator control	4X7
24	Switch - push, No.3 IDG parallel assist	3X313
25	Indicator - magnetic, No.3 GCB position	3X8

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (UPPER)	EQUIP. IDENT.
26	Switch - toggle, No.3 generator control	3X7
27	Meter - KW/KVAR, No.4 generator	4X282
28	Switch - toggle, with guard, No.4 CSD disconnect	4X311
29	Caption light module - CSD 4, No.4 IDG low oil pressure warning	4X312
30	Switch - toggle, with guard, No.3 CSD disconnect	3X311
31	METER - KW/KVAR, No.3 generator	3X282
32	Caption light module - CSD 3, No.3 IDG low oil pressure warning	3X312
33	Indicator - oil temperature, No.4 CSD	4D142
34	Indicator - oil temperature, No.3 CSD	3D142
35	Caption light module - GRND PWR AVAILABLE	X23
36	Switch - push, push for KVAR	X286
37	Indicator - oil temperature, No.2 CSD	2D142
38	Indicator - oil temperature, No.1 CSD	1D142
39	Switch - toggle, with guard, No.2 CSD disconnect	2X311
40	Caption - CSD 2, No.2 IDG low oil pressure warning	2X312
41	Meter - KW/KVAR, No.2 generator	2X282
42	Switch - toggle, with guard, No.1 CSD disconnect	1X311
43	Caption light module - CSD 1, No.1 IDG low oil pressure warning	1X312
44	Meter - KW/KVAR, No.1 generator	1X282

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (UPPER)	EQUIP. IDENT.
45	Switch - push, No.2 IDG parallel assist	2X313
46	Switch - toggle, No.2 generator control	2X7
47	Switch - push, No.1 IDG parallel assist	1X313
48	Switch - toggle, No.1 generator control	1X7
49	Caption light module - GEN 2, No.2 generator failure warning	2X13
50	Indicator - magnetic, No.2 GCB position	2X8
51	Caption light module - GEN 1, No.1 generator failure warning	1X13
52	Indicator - magnetic, No.1 GCB position	1X8
53	Caption light module - No.1 AC MAIN BUS	1X16

Minor Electrical Components on Electrical Generating Control Panel (Upper) (Ref. Fig.401)
Table 401

R **ON A/C 007-007,

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
1	Voltmeter - DC volts	D127
2	Cover - diode board, system A	1P36/40
3	Switch - rotary, DC voltmeter selector	D126
4	Indicator - magnetic, A system essential/ main split	1P14
5	Ammeter - A system battery	1P23
6	Switch - toggle, DC normal/split selector	P34

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
7	Caption light module - DC MAIN BUS, main failure warning	P17
8	Meter - frequency	D114
9	Cover - diode board	X234
10	Ammeter - B system battery	2P23
11	Indicator - magnetic, B system essential/ main split	2P14
12	Switch - rotary, AC frequency/volts selector	D115
13	Cover - diode board, system B	2P36/40
14	Switch - toggle, B system battery control	2P25
15	Voltmeter - AC volts	D113
16	Caption light module - battery FAIL/ISOL, B system	2P30
17	Indicator - magnetic, B system battery isolate	2P31
18	Caption light module - DC ESS BUS, B system essential fail warning	2P28
19	Switch - toggle, No.3 TRU control	3P3
20	Caption light module - O/HEAT, No.4 TRU	4P8
21	Switch - toggle, No.4 TRU control	4P3
22	Caption light module - O/HEAT, No.3 TRU	3P8
23	Ammeter - No.4 TRU	4P6
24	Ammeter - No.3 TRU	3P6
25	Switch - toggle, No.4 essential/main control	4X128
26	Switch - toggle, No.3 essential/main	3X128

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
	control	
27	Caption light module - AC ESS BUS, No.4 essential fail warning	4X129
28	Indicator - magnetic, No.4 essential/ main isolate	4X130
29	Caption light module - AC ESS BUS, No.3 essential fail warning	3X129
30	Indicator - magnetic, No.3 essential/ main isolate	3X130
31	Switch - toggle, with guard, emergency generator mode selector	X218
32	Caption light module - SELECTED, emergency generator	X221
33	Indicator - magnetic, ASB position	X225
34	Meter - KVA, emergency generator	X205
35	Caption light module - FAIL, emergency generator	X222
36	Caption light module - O/HEAT, emergency generator	X209
37	Switch - toggle, with guard, emergency generator isolate	2X219
38	Indicator - magnetic, No.2 essential/ main isolate	2X130
39	Caption light module - AC ESS BUS, No.2 essential fail warning	2X129
40	Indicator - magnetic, No.1 essential/ main isolate	1X130
41	Caption light module - AC ESS BUS, No.1 essential fail warning	1X129
42	Switch - toggle, No.2 essential/main	2X128

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
	control	
43	Switch - toggle, No.1 essential/main control	1X128
44	Ammeter - No.2 TRU	2P6
45	Ammeter - No.1 TRU	1P6
46	Caption light module - O/HEAT, No.2 TRU	2P8
47	Caption light module - O/HEAT, No.1 TRU	1P8
48	Switch - toggle, No.1 TRU control	1P3
49	Caption light module - DC ESS BUS, A system essential fail warning	1P28
50	Switch - toggle, No.2 TRU control	2P3
51	Indicator - magnetic, A system battery isolate	1P31
52	Switch - toggle, A system battery control	1P25
53	Caption light module - battery FAIL ISOL, A system	1P130

Minor Electrical Components on Electrical Generating Control Panel (Lower) (Ref. Fig.402)
Table 402

R **ON A/C 001-006,

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
1	Voltmeter - DC volts	D127
2	Switch - rotary, DC voltmeter selector	D126
3	Indicator - magnetic, A system essential/	1P14

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
	main split	
4	Cover - diode board	X234
5	Ammeter - A system battery	1P23
6	Caption light module - DC MAIN BUS, main failure warning	P17
7	Meter - frequency	D114
8	Ammeter - B system battery	2P23
9	Indicator - magnetic, B system essential/ main split	2P14
10	Switch - rotary, AC frequency/volts selector	D115
11	Switch - toggle, B system battery control	2P25
12	Voltmeter - AC volts	D113
13	Caption light module - BATT ISOLATE, B system	2P30
14	Indicator - magnetic, B system battery isolate	2P31
15	Caption light module - DC ESS BUS, B system essential fail warning	2P28
16	Switch - toggle, No.3 TRU control	3P3
17	Caption light module - O/HEAT, No.4 TRU	4P8
18	Switch - toggle, No.4 TRU control	4P3
19	Caption light module - O/HEAT, No.3 TRU	3P8
20	Ammeter - No.4 TRU	4P6
21	Ammeter - No.3 TRU	3P6
22	Switch - toggle, No.4 essential/main	4X128

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
	control	
23	Switch - toggle, No.3 essential/main control	3X128
24	Caption light module - AC ESS BUS, No.4 essential fail warning	4X129
25	Indicator - magnetic, No.4 essential/main isolate	4X130
26	Caption light module - AC ESS BUS, No.3 essential fail warning	3X129
27	Indicator - magnetic, No.3 essential/main isolate	3X130
28	Switch - toggle, with guard, emergency generator mode selector	X218-
29	Caption light module - SELECTED, emergency generator	X221
30	Indicator - magnetic, ASB position	X225
31	Meter - KVA, emergency generator	X205
32	Caption light module - FAIL, emergency generator	X222
33	Caption light module - O/HEAT, emergency generator	X209
34	Switch - toggle, with guard, emergency generator isolate	X219
35	Indicator - magnetic, No.2 essential/main isolate	2X130
36	Caption light module - AC ESS BUS, No.2 essential fail warning	2X129
37	Indicator - magnetic, No.1 essential/ main isolate	1X130
38	Caption light module - AC ESS BUS, No.1	1X129

KEY NO.	MINOR ELECTRICAL COMPONENTS - ELECTRICAL GENERATING CONTROL PANEL (LOWER)	EQUIP. IDENT.
	essential fail warning	
39	Switch - toggle, No.2 essential/main control	2X128
40	Switch - toggle, No.1 essential/main control	1X128
41	Ammeter - No.2 TRU	2P6
42	Ammeter - No.1 TRU	1P6
43	Caption light module - O/HEAT, No.2 TRU	2P8
44	Caption light module - O/HEAT, No.1 TRU	1P8
45	Switch - toggle, No.1 TRU control	1P3
46	Caption light module - DC ESS BUS, A system essential fail warning	1P28
47	Switch - toggle, No.2 TRU control	2P3
48	Indicator - magnetic, A system battery isolate	1P31
49	Switch - toggle, A system battery control	1P25
50	Caption light module - BATT ISOLATE, A system	1P130

Minor Electrical Components on Electrical Generating Control Panel (Lower) (Ref. Fig.402)
Table 402

3. Components in Flight Compartment Racking on Shelves 12-215 and 12-216 (Ref. Fig.404 and 405)

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 10.8 to 13.2 lbf in (0.122 to 0.149 mdaN)	-
Torque spanner, 60 to 70 lbf in (0.69 to 0.80 mdaN)	-
Torque spanner, 80 to 90 lbf in (0.90 to 1.02 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power equipment as detailed in 24-00-00, Servicing.

(2) Gain access to the electrical components on the appropriate shelf by opening the circuit breaker panels on the racking upper structure.

(3) If a d.c. distributing system contactor is to be removed, disconnect the associated battery (Ref. 24-33-11).

CAUTION: THE ASSEMBLY ORDER OF BUSBAR/CABLES TO A TERMINAL POST MUST BE BUSBAR FIRST, IF FITTED, FOLLOWED BY CABLES IN SIZE ORDER WITH THE LARGEST CABLE FIRST.

NOTE: Where applicable, the order of assembly of cable terminations and clamping washers at equipment terminals must be noted, to ensure correct installation. If identification markings on electrical cables are not easily discernible, the cables must be tagged before removal to ensure correct connection during installation.

C. Remove AC Contactor

(1) Remove the contactor terminal cover, where applicable.

(2) Disconnect the electrical busbar/cables from the terminals, and from terminal posts where applicable.

(3) Remove the bolts securing the contactor to the mounting base and remove the contactor from the shelf.

(4) Refit the terminal cover to the contactor, where applicable.

D. Install AC Contactor

(1) Comply with the electrical safety precautions.

(2) Remove the contactor terminal cover, where applicable.

(3) Mount the contactor on the mounting base and secure it with the bolts.

(4) Connect the electrical busbar/cables to the terminals, and terminal posts where applicable, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagrams. Torque-tighten the terminal screws in accordance with 20-27-14. Torque-tighten heavy duty connections to terminal posts to between 60 and 70 lbf in (0.69 and 0.80 mdaN).

(5) Refit the terminal cover to the contactor, where applicable.

(6) Check that the contactor is bonded in accordance with 20-27-11.

E. Remove DC Contactor

(1) Disconnect the electrical connector from the associated battery (Ref. 24-33-11).

(2) Disconnect the electrical cables from the terminals.

(3) Release the nuts and bolts connecting the essential busbar assembly and release the busbar links from the contactor studs.

(4) Remove the bolts and washers securing the contactor to the mounting bracket and withdraw the contactor from the shelf.

F. Install DC Contactor

(1) Comply with the electrical safety precautions.

(2) Place the contactor on its mounting bracket and move the contactor and the busbar assembly until the busbar links fit over the appropriate contactor studs.

(3) Secure the contactor to the mounting bracket with the bolts and washers.

(4) On the busbar assembly, check that the rear end of the fuse is assembled on top of the link and the forward end of the fuse is assembled between the links. Torque-tighten the fuse carrier connecting nuts to between 80 and 90 lbf in (0.90 and 1.02 mdaN).

(5) Secure the links to the contactor heavy duty studs with the terminal nuts. Torque-tighten the nuts to between 80 and 90 lbf in (0.90 and 1.02 mdaN).

(6) Connect the electrical cables to the terminals, ensuring that the connections are made in accordance with the cable identification and the applicable wiring diagram. Torque-tighten the heavy duty terminal nuts to between 80 and 90 lbf in (0.90 and 1.02 mdaN). Torque-tighten the terminal screws to between 10 and 12 lbf in (0.11 and 0.14 mdaN).

(7) Check that the contactor is bonded in accordance with 20-27-11.

(8) Connect the electrical connector to the battery (Ref. 24-33-11).

G. Remove Reverse Current Circuit Breaker (RCB)

(1) Disconnect the electrical cable from the RCB terminal post.

(2) Release the nuts and bolts connecting the essential busbar assembly and release the busbar link from the RCB terminal stud.

(3) Remove the screws securing the RCB to the mounting bracket and withdraw the RCB from the shelf.

H. Install Reverse Current Circuit Breaker (RCB)

(1) Comply with the electrical safety precautions.

(2) Place the RCB on its mounting bracket and move the RCB and the busbar assembly until the busbar link fits over the RCB terminal stud.

(3) Secure the RCB to the mounting bracket with the screws.

(4) On the busbar assembly, check that the rear end of the fuse is assembled on top of the link and the forward end of the fuse is assembled between the links. Torque-tighten the busbar connecting nuts to between 80 and 90 lbf in (0.90 and 1.02 mdaN).

(5) Secure the link to the RCB terminal stud with the terminal nut. Torque-tighten the nut to between 80 and 90 lbf in (0.90 and 1.02 mdaN).

(6) Connect the electrical cable to the RCB heavy duty terminal post with the terminal nut. Torque-tighten the nut to between 80 and 90 lbf in (0.90 and 1.02 mdaN).

(7) Check that the RCB is bonded in accordance with 20-27-11.

I. Remove Relay

(1) Remove the nuts and washers securing the relay to its mounting base and withdraw the relay from the socket.

J. Install Relay

(1) Comply with the electrical safety precautions.

(2) Align the locating pin on the relay body with the locating hole in the relay mounting base and plug the relay into the socket.

(3) Secure the relay body to the socket with the nuts and washers.

K. Remove Diode (Shelf 12-215 only)

(1) Remove the nut from the cathode end of the diode and unsolder the opposite end from the electrical cable. Withdraw the diode from the heat sink.

L. Install Diode (Shelf 12-215 only)

(1) Comply with the electrical safety precautions.

(2) Fit the diode to the heat sink so that the stud on the diode (cathode end) is pointing to the rear of the shelf.

(3) Secure the cathode end with the nut. Torque-tighten the nut to between 10.8 and 13.2 lbf in (0.122 and 0.149 mdaN). Solder the opposite end to the electrical cable in accordance with the Wiring Diagram Manual, 20-42-23, ensuring that the connection is made in accordance with the cable identification and the applicable wiring diagram.

M. Remove Shunt (Shelf 12-215 only)

(1) Remove the terminal cover from the shunt.

(2) Disconnect the electrical cables from the shunt.

(3) Remove the bolts and washers securing the shunt to its mounting base and withdraw the shunt from the shelf.

N. Install Shunt (Shelf 12-215 only)

(1) Comply with the electrical safety precautions.

(2) Fit the shunt to its mounting base and secure it with the bolts and washers.

(3) Remove the terminal cover from the shunt.

(4) Connect the electrical cables to the shunt terminals, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(5) Refit the terminal cover to the shunt.

(6) Check that the shunt is bonded in accordance with 20-27-11.

O. Remove KVA Meter Current Transformer (Shelf 12-215 only)

NOTE: Note the order of assembly of cable terminations and washers at the terminals and terminal post, to ensure correct installation.

(1) Disconnect the electrical cables from the transformer

terminals.

(2) Release the transformer from the cable passing through its core, by disconnecting the cable from the adjacent heavy duty terminal block.

(3) Remove the bolts and washers securing the transformer to its mounting and withdraw the transformer from the shelf.

P. Install KVA Meter Current Transformer (Shelf 12-215 only)

(1) Comply with the electrical safety precautions.

(2) Place the transformer on its mounting base with the terminal lugs pointing toward the adjacent terminal block. Secure the transformer to the base with the bolts and washers.

(3) Connect the electrical cables to the transformer terminals with the nuts and screws, ensuring that the order of assembly of cable terminations and washers is correct and that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(4) Check that the transformer is bonded in accordance with 20-27-11.

(5) Pass the electrical cable through the transformer core and connect the cable to the adjacent heavy duty terminal block, ensuring that the connection is made in accordance with the cable identification and the applicable wiring diagram. Torque-tighten the terminal connection on the terminal block to between 60 and 70 lbf in (0.69 and 0.80 mdaN).

Q. Renew Neon Indicator

(1) Unscrew the neon indicator knob to release it from the holder, and withdraw the neon indicator from the knob.

(2) Insert a replacement neon indicator into the indicator knob, and screw the knob into the holder until it is fully engaged.

R. Conclusion

(1) Close the circuit breaker panels and secure them

with the quick-release fasteners.

(2) Cancel the electrical safety precautions taken before removal, and make available electrical ground power as detailed in 24-41-00.

(3) Check the operation of the component by carrying out the appropriate test procedure. To check the main a.c. generation 'power on' neon indicators, open the appropriate circuit breaker panel (13-215 No.1 main, 14-215 No.2 main, 13-216 No.3 main and 14-216 No.4 main) and check that the appropriate neon indicator is glowing. Close the appropriate panel and secure it with the quick-release fasteners.

4. Components on Flight Compartment Racking Panels 24-215 and 24-216 (Ref. Fig. 406)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 119 to 131 lbf in (1.35 to 1.48 mdaN)	-
Torque spanner, 240 to 265 lbf in (2.71 to 2.99 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Gain access to panel 24-215 by removing the service trolleys stowed under the galley working surface and, if necessary, dismantling the galley structure as detailed in Chapter 25. Release the quick-release fasteners securing the lower access panel to the racking and remove the panel.

R (3) Gain access to panel 24-216 by removing the furnishing
R equipment as detailed in Chapter 25.

CAUTION: CONTACTORS ARE SUPPLIED WITH ONE THICK WASHER, ONE THIN WASHER AND A SPRING WASHER TO EACH TERMINAL POST. THE SPRING WASHER MUST BE PLACED DIRECTLY UNDER THE TERMINAL NUT AND

THE THIN WASHER UNDER THE SPRING WASHER. THE THICK WASHER MUST BE USED ONLY ON BUS-TIE BREAKER CONTACTORS UNDER THE BUSBARS ON TERMINALS B1, B2 AND B3, AND ON SPLIT SYSTEM BREAKER CONTACTORS UNDER THE BUSBARS ON TERMINALS A1, A2 AND A3.

THE ASSEMBLY ORDER OF BUSBAR/CABLES TO A CONTACTOR TERMINAL POST MUST BE BUSBAR FIRST, IF APPLICABLE, FOLLOWED BY CABLES IN SIZE ORDER WITH THE LARGEST CABLE FIRST.

C. Remove Contactors (BTBs, SSBs, GCBs and GPB)

(1) Remove the cover from the contactor terminals.

(2) Disconnect the electrical cables from the contactor main terminal studs, noting the order of assembly of cable terminations and washers at the contactor terminals, to ensure correct installation.

(3) Disconnect the electrical connector from the connector on the side of the contactor.

(4) Remove the screws and washers securing the contactor to the panel and withdraw the contactor from the racking.

D. Install Contactors (BTBs, SSBs, GCBs and GPB)

(1) Comply with the electrical safety precautions.

(2) Fit the contactor to its mounting on the panel, ensuring that the electrical connector on the contactor is facing left, and secure it with the screws and washers.

(3) Remove the terminal cover from the contactor.

(4) Connect the electrical cables to the contactor main terminals, ensuring that the order of assembly of cable terminations and washers is correct and that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminal nuts to between 119 and 131 lbf in (1.35 and 1.48 mdaN).

(5) Refit the terminal cover to the contactor.

(6) Connect the electrical connector to the contactor,

ensuring that the mating surfaces are clean and undamaged.

(7) Check that the contactor is bonded in accordance with 20-27-11.

E. Remove KW/KVAR Meter Current Transformer

(1) Disconnect the electrical cables from the transformer terminals, noting the order of assembly of cable terminations and washers at the terminals, to ensure correct installation.

(2) Release the transformer from the cable passing through its core by disconnecting the cable from the adjacent terminal block.

(3) Remove the screws and washers securing the transformer to its mounting and withdraw the transformer from the panel.

F. Install KW/KVAR Meter Current Transformer

(1) Comply with the electrical safety precautions.

(2) Place the transformer on its mounting with the terminal lugs pointing down. Secure the transformer to its mounting with the screws and washers.

(3) Connect the electrical cables to the transformer terminals with the nuts and screws, ensuring that the order of assembly of cable terminations and washers is correct and that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(4) Check that the transformer is bonded in accordance with 20-27-11.

(5) Pass the electrical cable through the transformer core and connect the cable to the adjacent heavy duty terminal block, ensuring that the connection is made in accordance with the cable identification and the applicable wiring diagram. Torque-tighten the terminal nut on the heavy duty terminal block to between 240 and 265 lbf in (2.71 and 2.99 mdaN).

G. Renew Neon Indicator

(1) Unscrew the neon indicator knob to release it from

the holder, and withdraw the neon indicator from the knob.

(2) Insert a replacement neon indicator into the indicator knob, and screw the knob into the holder until it is fully engaged.

H. Conclusion

WARNING: SUBSEQUENT PROCEDURES REQUIRE THE TESTING OF 200/115 V AC CONTROL EQUIPMENT WITH POWER APPLIED AND ACCESS PANELS REMOVED. PLACE SUITABLE WARNING PLACARDS (Ref. 11-00-00) IN THE AREA AND ENSURE THAT PERSONNEL ARE CLEAR WHILST POWER IS ON.

(1) Cancel the electrical safety precautions taken before removal, and make available electrical ground power as detailed in 24-41-00.

(2) Check the operation of the component by carrying out the appropriate test procedure. With main a.c. power on, check that the appropriate neon indicator is glowing.

(3) On panel 24-215, fit the access panel to the racking and secure it with the quick-release fasteners. If necessary, assemble the galley structure as detailed in Chapter 25. Stow the service trolleys under the galley working surface.

R (4) Fit the furnishing equipment over panel 24-216
R as detailed in Chapter 25.

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GENERAL - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00, SERVICING.

OBSERVE THE HYDRAULIC FLUID SAFETY PRECAUTIONS DETAILED IN 29-00-00.

1. General

This topic comprises an Operational Test and a Functional Test of the electrical power system. Leading information concerning electrical bonding is also included (Ref. para.4.).

The appropriate System Test, because of its length and complexity, is sub-divided and covered in the associated sub-systems.

The Operational Test (Ref. para.2.) checks the operation of certain controls that are not normally operated on each flight. This test is usually all that is required after routine servicing.

The Functional Test (Ref. para.3.) checks control and protection circuits in which failure may not be apparent under normal operating conditions. It is divided, for convenience of application, into a series of tests identified under separate sub-headings as follows:-

Emergency Generation Preliminary Functional Test

Emergency Generator Overheat Indication Functional Test

26 V 400 Hz AC Generation Functional Test

'A' and 'B' Avionics 115 V 400 Hz AC Busbars Functional Test

115/26 V AC Standby Inverter Supplies and Control Functional Test

DC Essential/Main Split - AC Undervolt Control Functional Test

Battery Charge Control Functional Test

Main Generation Dormant Circuits Functional Test

Emergency Generation Functional Test - Using Hydraulic

Ground Power

AC and DC Generation Master Warning Functional Test

AC Generation Functional Test - Using Main Engines

At the conclusion of individual tests certain operations, e.g., switching off electrical ground power, may be omitted provided that a sequential test validates the omission.

2. Operational Test

A. Prepare

(1) Make available electrical ground power as detailed in 24-41-00.

B. Test

(1) Set BATT A and BATT B control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(2) Set BATT A and BATT B control switches to "NORM" and check that the associated 'battery isolate' magnetic indicators remain in-line.

(3) Set the DC NORM/SPLIT control switch to "SPLIT" and check that both 'A' and 'B' essential/main split magnetic indicators change from in-line to cross-line and that both 'A' and 'B' 'battery isolate' magnetic indicators remain in-line. Return the switch to "NORM" and check that both 'A' and 'B' essential/main split magnetic indicators return to in-line. Return BATT A and BATT B control switches to "ON".

(4) Set the split system breaker (SSB) control switch to "OPEN" and check that both SSBs open, by observing that all four AC MAIN BUS captions are illuminated. Check also that the SSB position magnetic indicator changes from in-line to cross-line.

NOTE: The AC ESS BUS captions will also be illuminated.

(5) Return the SSB control switch to "CLOSE" and check that the four AC MAIN BUS captions are

extinguished and the SSB position magnetic indicator changes from cross-line to in-line.

(6) Set No.1 bus-tie breaker (BTB) control switch to "TRIP" and check that -

(a) the correspondingly-numbered BTB position magnetic indicator changes from in-line to cross-line,

(b) the correspondingly-numbered essential/main isolate magnetic indicator changes from in-line to cross-line, and

(c) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are illuminated.

(7) Return No.1 BTB control switch to "NORM" and check that -

(a) the correspondingly-numbered BTB position magnetic indicator changes from cross-line to in-line,

(b) the correspondingly-numbered essential/main isolate magnetic indicator changes from cross-line to in-line, and

(c) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are extinguished.

(8) Repeat operations (6)and (7) as applied to Nos.2, 3 and 4 BTB control switches.

(9) Set each transformer rectifier (TRU) control switch, in turn, to "ISOL" and check that each TRU ammeter indication falls to zero as the associated ISOL setting is made. When all four TRUs are isolated, check that the DC MAIN BUS caption is illuminated and both 'A' and 'B' essential/main split magnetic indicators display cross-line.

NOTE: Isolation of the d.c. main busbar is initiated by undervolt detectors that have an inverse time delay and, normally, d.c. main busbar isolation will occur between 2 and 10 s after the last TRU is switched off.

(10) With the four TRUs isolated, set BATT A control

switch to "OFF" and check that 'A' system DC ESS BUS caption is illuminated.

(11) Return BATT A control switch to "ON" and check that the 'A' system DC ESS BUS caption is extinguished.

(12) Repeat operations (10) and (11) as applied to BATT B.

(13) Return all four TRU control switches to "NORM" and check that the DC MAIN BUS caption is extinguished and both 'A' and 'B' essential/main split magnetic indicators return to in-line.

CAUTION: ILLUMINATION OF THE "FAIL" SECTION OF A "BATT-FAIL/ISOL" CAPTION INDICATES A 'RUNAWAY' CONDITION OF THE ASSOCIATED BATTERY. THIS INDICATION REQUIRES IMMEDIATE ACTION TO INVESTIGATE THE CAUSE.

(14) Check on both 'A' and 'B' BATT-FAIL/ISOL captions that the FAIL section is not illuminated.

(15) Set the emergency generator mode switch to "MANUAL" and check that the SELECTED and FAIL captions are illuminated.

(16) Set the emergency generator isolate switch to "ISOL" and check that the SELECTED and FAIL captions are extinguished. Return the switch to "NORM" and check that the SELECTED and FAIL captions are again illuminated.

(17) Set the emergency generator mode switch to "GRD BY-PASS" and check that the SELECTED and FAIL captions are illuminated.

(18) Repeat operation (16).

(19) Set the emergency generator isolate switch to "ISOL" and check that the SELECTED and FAIL captions are extinguished.

(20) Return the emergency generator mode switch to "AUTO".

(21) Return the emergency generator isolate switch to "NORM" and check that the SELECTED and FAIL captions are not illuminated.

(22) Set BATT A and BATT B control switches to "OFF" and check that the associated 'battery isolate' magnetic indicators change from in-line to cross-line and that the ISOL sections of both BATT-FAIL/ISOL captions are illuminated.

C. Conclusion

(1) Switch off and disconnect electrical ground power as detailed in 24-41-00.

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3. Functional Test

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Decade resistance boxes, range 100 - 200 ohm (two), required for Emergency Generator Overheat Indication Functional Test	-
Test lamps, 28 V, required (four) for 26 V 400 Hz AC Generation Functional Test, and (one) for 115/26 V AC Standby Inverter Supplies and Control Functional Test	-
Neon test indicators, 115 V (two), required for 'A' and 'B' Avionics 115 V 400 Hz AC Busbars Functional Test	-
Dormant circuit test set, required for Main Generation Dormant Circuits Functional Test	TE.5002.000
Throttle control system	QT6A16-24

DESCRIPTION	PART NO.
test set, required for Emergency Generation Preliminary Functional Test	
Precision-grade a.c. voltmeter, range 110 - 125 V a.c., required for 115 /26 V AC Standby Inverter Supplies and Control Functional Test	-
Precision-grade frequency meter, range 350 - 450 Hz, required for 115/26 V AC Standby Inverter Supplies and Control Functional Test	-
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN), required for DC Essential/Main Split - AC Undervolt Control Functional Test	-

B. Emergency Generation Preliminary Functional Test

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN AND THE GREEN HYDRAULIC SYSTEM MUST NOT BE PRESSURIZED DURING THIS PRELIMINARY TEST.

CAUTION: SUBSEQUENT TEST PROCEDURES REQUIRE THE TRIPPING OF CIRCUIT BREAKERS, TO ESTABLISH LEFT-HAND AND RIGHT-HAND WEIGHT SWITCH OPERATED RELAYS IN THE 'IN-FLIGHT' POSITION. CARE MUST BE TAKEN TO ENSURE THAT ALL SERVICES ADVERSELY AFFECTED BY THIS CONDITION ARE PREVIOUSLY ISOLATED (REF. 7-11-00).

NOTE: The following test procedures include operation of the engine speed unit (ESU) internal relay in the emergency generator automatic start and auto shed breaker (ASB) control circuits. The required input of engine speed signals to the ESU is provided by the throttle control system test set connected and operated as detailed below.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Trip the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Fit safety clips to the tripped circuit breakers.

(c) Gain access to the engine control amplifiers (throttle amplifiers) mounted on shelves 6-215 and 8-215 by removing the appropriate panels from the flight compartment left-hand racking.

(d) Locate No.1 engine main control amplifier (1K20) mounted on shelf 8-215, and No.2 engine main control amplifier (2K20) mounted on shelf 6-215.

(e) On the pilots' roof panel, 4-211, ensure that -

e1) No.1 engine and No.2 engine AUTO-IGNITION control switches are set to OFF,

e2) No.1 engine and No.2 engine HP VALVE control switches are set to SHUT, and

e3) No.1 engine and No.2 engine THROTTLE MASTER switches are set to OFF.

(f) Place a warning placard in the flight compartment forbidding alteration of the switch settings specified in paragraphs e1), e2) and e3).

NOTE: The setting of Nos.1 and 2 engine throttle levers is not significant.

(2) Test

(a) Connect the throttle control system test set cable 2 between connector socket PL 2 on the test set and connector socket SKT 2 on the front of No.1 engine main control amplifier (1K20).

NOTE: The following test procedures do not require the setting of any control on the test set to a particular position; any setting will

provide a satisfactory test condition.

(b) Ensure that the emergency generator isolate switch is at NORM. Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator SELECTED and FAIL captions are illuminated.

(c) Observe No.1 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, checking that the pointer on No.1 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(d) With the reading on No.1 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that -

d1) the emergency generator SELECTED and FAIL captions are extinguished, and

d2) the ASB position magnetic indicator changes from cross-line to in-line.

(e) Trip the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and check that when the reading on No.1 engine HP RPM (N2) indicator falls below approximately 58 per cent N2, -

e1) the emergency generator SELECTED and FAIL captions are illuminated, and

e2) the ASB position magnetic indicator changes from in-line to cross-line.

(f) Fit a safety clip to the circuit breaker tripped in operation (e).

(g) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.1 engine main control amplifier and reconnect it to connector socket SKT 2 on the front of No.2 engine main control amplifier (2K20).

(h) Observe No.2 engine HP RPM (N2) indicator on the pilots' centre instrument panel,

6-211. Remove the safety clip and reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(i) With the reading on No.2 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that -

i1) the emergency generator SELECTED and FAIL captions are extinguished, and

i2) the ASB position magnetic indicator changes from cross-line to in-line.

(j) Set No.1 essential/main (NORM/EMERG) control switch to "EMERG" and check that the correspondingly-numbered essential/ main isolate magnetic indicator changes from in-line to cross-line and that the correspondingly-numbered AC ESS BUS caption is illuminated. Check also that the emergency generator SELECTED and FAIL captions are illuminated.

(k) Return No.1 essential/main (NORM/EMERG) control switch to "NORM" and check that the correspondingly-numbered essential/ main isolate magnetic indicator returns to in-line, and that the correspondingly-numbered AC ESS BUS caption and the emergency generator SELECTED and FAIL captions are extinguished.

(l) Repeat operations (j) and (k) as applied to Nos.2, 3 and 4 essential/main (NORM/ EMERG) control switches.

(m) Trip the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, and check that when the reading on No.2 engine HP RPM (N2) indicator falls below approximately 58 per cent N2 -

m1) the emergency generator SELECTED and FAIL captions are illuminated, and

m2) the ASB position magnetic indicator

changes from in-line to cross-line.

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(n) Set the emergency generator isolate switch to "ISOL" and the mode switch to "AUTO", then set the isolate switch to "NORM" and check that the emergency generator SELECTED and FAIL captions are extinguished.

(p) Observe No.2 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(q) With the reading on No.2 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that the emergency generator FAIL and SELECTED captions remain extinguished.

(r) Repeat operation (j).

(s) Return No.1 essential/main (NORM /EMERG) control switch to "NORM" and check that the correspondingly numbered essential/main isolate magnetic indicator returns to in-line and the correspondingly numbered AC ESS BUS caption is extinguished. Check that the emergency generator SELECTED and FAIL captions remain illuminated.

(t) Trip the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, and check that when the reading on No.2 engine HP RPM (N2) indicator falls below approximately 58 per cent N2, the emergency generator SELECTED and FAIL captions remain illuminated.

(u) Fit a safety clip to the circuit breaker tripped in operation (t).

(v) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and remain extinguished.

(w) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(x) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.2 engine main control amplifier and from connector socket PL 2 on the test set. Remove the test set, fit the captive protection caps to connector sockets SKT 2 on Nos.1 and 2 engine main control amplifiers and refit the panels removed to gain access to shelves 6-215 and 8-215.

(y) Remove the safety clips and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Remove the warning placard placed in operation (1)(f).

(z) Establish the left-hand and right-hand weight switch operated relays in the 'in-flight' position by tripping the following circuit breakers; ensure that all services adversely affected by this condition are isolated (Ref. 7-11-00). Fit safety clips to the tripped circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
LH UC WEIGHT SW & DOWNLOCK 'B' SYS SUP	3-213	G293	B8
RH UC WEIGHT SW 'B' SYS SUP	3-213	G294	B9

(aa) Check that the emergency generator mode switch is set to AUTO. Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the emergency generator

SELECTED and FAIL captions are illuminated.

(ab) Establish the left-hand and right-hand weight switch operated relays in the 'ground' position by removing the safety clips and resetting the two circuit breakers tripped in operation (z) and check that the SELECTED and FAIL captions remain illuminated. Ensure that the weight switch relay controlled services isolated in accordance with the provisions of operation (z) are reinstated as required.

(ac) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and remain extinguished.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

C. Emergency Generator Overheat Indication Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9, and fit safety clips.

(b) Gain access to the emergency generator by opening access door 153 DB (Ref. 52-41-41) and disconnect the electrical connector (X200-A) from the emergency generator.

(c) Connect a decade resistance box between pins A and B of the emergency generator 'free' connector (X200-A) and another decade resistance box between pins G and H. Set each box at 100 ohm.

(d) Make available electrical ground power as detailed in 24-41-00.

(e) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10.

(2) Test

(a) Set the emergency generator mode switch to "GRD BY-PASS" and check that the SELECTED and FAIL captions are illuminated.

(b) Progressively increase the resistance on the resistance box connected between pins A and B and check that the emergency generator O/HEAT caption and the master warning red ELEC caption are illuminated when the resistance is at a setting within the range 162 to 167 ohm. Reset the resistance box to 100 ohm and check that the emergency generator O/HEAT caption and the master warning red ELEC caption are extinguished.

(c) Repeat operation (b) as applied to the resistance box connected between pins G and H.

(d) Set the emergency generator isolation switch to "ISOL" and the mode switch to "AUTO". Check that the SELECTED and FAIL captions are extinguished, then set the isolation switch to "NORM".

(3) Conclusion

(a) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(b) Disconnect and remove the decade resistance boxes and reconnect the electrical connector to the emergency generator, ensuring that the mating surfaces are clean and undamaged. Refit the access door removed in operation (1)(b).

(c) Remove the safety clips and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10 and the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9.

(d) Switch off and disconnect electrical ground power as detailed in 24-41-00.

D. 26 V 400 Hz AC Generation Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Isolate the 26 V a.c. main and essential busbars by tripping the circuit breakers listed below. Fit safety clips to the tripped circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
'A' SYS 26 V AC TRANS SUP	2-213	1X131	D18
'B' SYS 26 V AC TRANS SUP	4-213	2X131	B13

(d) Gain access to the 26 V 'A' and 'B' main busbars on panels 13-215 and 13-216 respectively and the 26 V 'A' and 'B' essential busbars on panels 2-213 and 4-213 respectively by opening these circuit breaker panels.

(e) Connect 28 V test lamps, one between each 26 V a.c. busbar and earth; test lamp connection points, suitable for each busbar, are as follows:-

'A' main busbar: Terminal 1 of circuit breaker D81 on panel 13-215, map ref.D1.

'B' main busbar: Terminal 1 of circuit breaker H1010 on panel 13-216, map ref.D19.

'A' essential busbar: Terminal 1 of circuit breaker 1F78 on panel 2-223, map ref.A2.

'B' essential busbar: Terminal 1 of circuit breaker D211 on panel 4-213, map ref.E3.

(f) Remove the safety clips and reset the circuit breakers tripped in operation (c).

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Check that the four test lamps connected in operation (1)(e) are all lit.

(b) Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG" and check that the test lamps connected to the 26 V a.c. 'A' and 'B' busbars go out.

(c) Return Nos.2 and 3 essential/main (NORM/EMERG) control switches to "NORM" and check that the test lamps connected to the 26 V a.c. 'A' and 'B' busbars are lit.

(3) Conclusion

(a) Repeat operations (1)(b) and (c).

(b) Disconnect and remove the four test lamps. Close and secure the circuit breaker panels opened in operation (1)(d).

(c) Remove the safety clips and reset the circuit breakers tripped in operation (1)(c).

(d) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

E. 'A' and 'B' Avionics 115 V 400 Hz AC Busbars Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Isolate the 'A' and 'B' systems avionics busbars by tripping the circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
AVIONIC LOAD SHED 'A' SYS SUP	21-215	1X520	-
AVIONIC LOAD SHED 'B' SYS SUP	21-216	2X520	-

(d) Gain access to the 115 V 400 Hz 'A' and 'B' avionics busbars on panels 13-215 and 13-216 respectively, by opening these circuit breaker panels.

(e) Connect 115 V neon test indicators, one between each 115 V avionics busbar and earth. Neon indicator connection points, suitable for each busbar, are as follows:-

'A' avionics busbar: Terminal 1 of circuit breaker 1C18 on panel 13-215,

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map ref.A5.

'B' avionics busbar: Terminal 1 of circuit breaker 2S4 on panel 13-216, map ref.G19.

(f) Remove the safety clips and reset the circuit breakers tripped in operation (c).

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Check that both neon indicators connected in operation (1)(e) are lit.

(b) Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG" and check that both neon test indicators go out; return both switches to "NORM" and ensure that both neon test indicators are lit.

(3) Conclusion

(a) Repeat operations (1)(b) and (c).

(b) Disconnect and remove the two neon test indicators. Close and secure the circuit breaker panels opened in operation (1)(d).

(c) Remove the safety clips and reset the circuit breakers tripped in operation (1)(c).

(d) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

F. 115/26 V AC Standby Inverter Supplies and Control Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as

detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Isolate the 115 V and 26 V a.c. standby busbars by tripping the 115 V A.C. STBY TRANS SUP circuit breaker X137 on panel 2-213, map ref.B22. Fit a safety clip to the tripped circuit breaker.

(d) Gain access to the 115 V and 26 V a.c. standby busbars on panel 2-213 by opening this circuit breaker panel.

(e) Connect the 110 - 125 V a.c. voltmeter and the 350 - 450 Hz frequency meter between the 115 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker X134 on panel 2-213, map ref.C18, as a suitable point for connection of the voltmeter and frequency meter to the busbar.

(f) Connect a 28 V test lamp between the 26 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker 1F88, map ref.B1, as a suitable point for connection of the test lamp to the busbar.

(g) Remove the safety clip and reset the circuit breaker tripped in operation (1)(c).

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Check that -

a1) the supply voltage and frequency (approx. 115 V 400 Hz) are indicated on the test voltmeter and frequency meter connected to the 115 V a.c. standby busbar, and

a2) the test lamp connected to the 26 V a.c. standby busbar is lit.

(b) Set the ground power control switch to "TRIP" and release it. Check that the indications on

the test voltmeter and frequency meter fall to zero and the test lamp goes out.

(c) Isolate the 115 V a.c. standby busbar from the 'normal' supply busbar (No.1 essential) by tripping the 115 V A.C. STBY TRANS SUP circuit breaker X137 on panel 2-213, map ref.B22. Fit a safety clip to the tripped circuit breaker.

(d) Set the ground power control switch to "CLOSE" and release it. Check that the indications on the test voltmeter and frequency meter remain at zero and the test lamp remains out.

WARNING: THE CONTROL SWITCHES ON THE RAM AIR TURBINE (RAT) CONTROL PANEL ARE EACH GUARDED TO PERMIT OPERATION OF A SWITCH TO THE 'TEST' POSITION ONLY, AS REQUIRED FOR THE FOLLOWING TEST.

THESE GUARDS MUST NOT BE RAISED SINCE OPERATION OF EITHER SWITCH TO THE 'ON' POSITION WILL INITIATE THE AUTOMATIC EXTENSION OF THE RAM AIR TURBINE TO ITS OPERATIONAL POSITION BENEATH THE AIRCRAFT.

(e) On the ram air turbine control panel (14-214), set one of the two control switches to "TEST" and hold. Check that -

e1) the TEST caption on the panel is illuminated,

e2) the static inverter (X140) is energized and its output is connected to the 115 V a.c. standby busbar, by observing the indications on the test voltmeter and frequency meter, and

e3) the voltage and frequency of the static inverter so indicated are correct, i.e., 115(+5 -8.5) V 400(±8) Hz.

(f) Release the RAT switch held at TEST to "OFF". Check that -

f1) the TEST caption is extinguished and

f2) the indications on the test voltmeter and frequency meter fall to zero, indicating

that the static inverter power supply is removed from the 115 V a.c. standby busbar.

(g) Repeat operations (e) and (f), using the other one of the two control switches on the ram air turbine control panel.

(h) Remove the safety clip and reset the circuit breaker tripped in operation (c). Check that the supply voltage and frequency (approx. 115 V 400 Hz) are indicated on the testmeters and the test lamp is lit.

(3) Conclusion

(a) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(b) Disconnect and remove the test voltmeter and frequency meter and the test lamp. Close and secure the circuit breaker panel opened in operation (1)(d).

(c) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

R **ON A/C 007-007,

G. DC Essential/Main Split - AC Undervolt Control Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Gain access to No.3 main a.c. undervolt unit 3X15 on shelf 12-216 by opening the appropriate

circuit breaker panel. Remove the terminal cover, then disconnect and secure the cable from terminal 4 (earth) of the undervolt unit. Refit the terminal cover, then close and secure the circuit breaker panel.

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT A and BATT B control switches to "ON" and ensure that the DC NORM/SPLIT switch is at NORM. On the main generating control panel, check that No.3 AC MAIN BUS and No.3 AC ESS BUS captions are illuminated and that the 'A' and 'B' essential/main split magnetic indicators display in-line.

(b) Set Nos.1, 2 and 4 bus-tie breaker (BTB) control switches to "TRIP". Check that -

b1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are illuminated,

b2) the load on the d.c. main busbar is supplied by No.3 TRU as indicated on No.3 TRU ammeter, and

b3) both 'A' and 'B' system essential/main split magnetic indicators display cross-line.

NOTE: The loads on the 'A' and 'B' system essential d.c. busbars will be supplied by the batteries.

(c) Set No.1 BTB control switch to "NORM" and then back to "TRIP", checking that both 'A' and 'B' systems essential/main split magnetic indicators change from cross-line to in-line, and then back to cross-line.

(d) Repeat operation (c) applied in turn to Nos.2 and 4 BTB control switches.

(e) Set BATT A and BATT B control switches to "OFF". Check that the associated magnetic indicators change from in-line to cross-line.

(f) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground supply on.

(g) Gain access to No.3 main undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover and reconnect the cable to terminal 4 (earth) of the undervolt unit, checking the order of the terminal screw washers. Torque-tighten the terminal screw to between 12 and 14 lbf in (0.137 and 0.160 mdaN). Refit the terminal cover. Close and secure the circuit breaker panel.

(h) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT A and BATT B control switches to "ON".

(i) Ensure that Nos.1, 2 and 4 BTB control switches are at TRIP and that No.3 BTB control switch is at NORM, then check that -

i1) Nos.1, 2 and 4 AC MAIN BUS captions and Nos.1, 2 and 4 AC ESS BUS captions are illuminated,

i2) No.3 AC MAIN BUS and No.3 AC ESS BUS captions are extinguished,

i3) the d.c. load is supplied only by No.3 TRU as indicated on No.3 TRU ammeter, and

i4) both 'A' and 'B' essential/main split magnetic indicators display in-line.

(j) Set Nos.1, 2 and 4 BTB control switches to "NORM" and check that -

j1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished,

j2) both 'A' and 'B' essential/main split magnetic indicators remain in-line, and

j3) the d.c. load is supplied by Nos.1, 2, 3 and 4 TRUs as indicated on Nos.1, 2, 3

and 4 TRU ammeters.

(k) Set the DC VOLTS selector switch to "MAIN A" or "MAIN B" and check that approximately 28 V is indicated on the d.c. voltmeter, i.e., nominal d.c. voltage.

(l) Set each TRU control switch, in turn, to "ISOL" and check that each TRU ammeter indication falls to zero as the associated ISOL selection is made. When all four TRUs are isolated, check that the d.c. volts indication falls to zero, the DC MAIN BUS caption is illuminated and both 'A' and 'B' essential/main split magnetic indicators display cross-line.

NOTE: Isolation of the d.c. main busbar is initiated by undervolt detectors that have an inverse time delay and, normally, d.c. main busbar isolation will occur between 2 and 10 s after the last TRU is switched off.

(m) Return all four TRU control switches to "NORM" and check that the d.c. voltmeter registers the nominal d.c. voltage, the DC MAIN BUS caption is extinguished and the essential/ main split magnetic indicators display in-line.

(n) Set BATT A and BATT B control switches to "OFF" and check that the associated magnetic indicators change from in-line to cross-line.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

H. Battery Charge Control Functional Test

(1) Prepare

(a) Ensure that 'A' battery and 'B' battery are serviceable and fully charged.

(b) Make available electrical ground power as detailed in 24-41-00.

(c) Open the forward underfloor service

compartment door (123 AB) (Ref. 52-41-11) to permit access to 'A' battery charge controller (1P35) and 'B' battery charge controller (2P35), mounted on the top surface of the weather radar racking in the forward underfloor racking zone.

(2) Test

(a) Check that the DC NORM/SPLIT switch is set to NORM.

(b) Check that both 'A' and 'B' battery control switches are set to OFF and that the associated 'battery isolate' magnetic indicators display cross-line.

(c) Check at 'A' and 'B' BATT - FAIL/ISOL captions that the ISOL section of each is illuminated and the FAIL section of each is extinguished.

(d) Locate the test button on the 'A' battery charge controller (1P35) and observe the associated BATT - FAIL/ISOL caption. Press, and hold depressed, the test button. Check that after a period of not less than 3 s or more than 6 s, the FAIL section of the associated BATT - FAIL/ISOL caption is illuminated and that after a period of not less than 8 s or more than 12 s, the light-emitting diode on the controller is illuminated.

(e) Release the test button on the controller and check that the FAIL section of the associated BATT - FAIL/ISOL caption and the light-emitting diode are extinguished.

(f) Repeat operations (d) and (e) as applied to the 'B' battery charge controller (2P35).

(g) Set the 'A' battery control switch to "ON". Check that the ISOL section of the associated BATT - FAIL/ISOL caption is extinguished, the FAIL section remains extinguished, and the associated 'battery isolate' magnetic indicator displays in-line.

(h) Set the 'A' battery control switch to "NORM". Check that the ISOL and FAIL sections of the associated BATT - FAIL/ISOL caption remain extinguished and the associated 'battery

isolate' magnetic indicator remains in-line.

NOTE: Battery charge control is automatic with the battery control switch at NORM. Thus, with a fully charged battery installed, the 'battery isolate' magnetic indicator will change to cross-line if the battery control switch is left at NORM for longer than 5 min.

(i) Repeat operations (g) and (h) as applied to the 'B' battery control switch.

(j) Set the DC NORM/SPLIT control switch to "SPLIT". Check that both 'A' and 'B' essential/main split magnetic indicators display cross-line and that both 'A' and 'B' 'battery isolate' magnetic indicators remain in-line.

(k) Set the DC NORM/SPLIT control switch to "NORM" and check that both 'A' and 'B' essential/main split magnetic indicators display in-line.

(l) Set both 'A' and 'B' battery control switches to "OFF".

(3) Conclusion

(a) Close the forward underfloor service compartment door (123 AB) (Ref. 52-41-11).

(b) Switch off and disconnect electrical ground power as detailed in 24-41-00.

I. Main Generation Dormant Circuits Functional Test

NOTE: This test includes the checking of BTB and GCB operation by the associated manual and automatic control equipment.

CAUTION: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Connect electrical ground power to the ground services distribution system only (Ref.

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24-41-00, Servicing, para.2.A.). If already connected, ensure that ground power is disconnected from the main a.c. distribution system by operation of the ground power control switch to the TRIP position.

(b) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(c) Gain access to Nos.1, 2, 3 and 4 control and protection units (CPUs) by removing the appropriate panels from the flight compartment racking.

NOTE: Nos.1, 2, 3 and 4 CPUs (1X3, 2X3, 3X3 and 4X3) are mounted on shelves 2-215, 1-215, 1-216 and 2-216 respectively.

(d) Ensure that BATT A and BATT B control switches are set to OFF.

(e) Set all four generator control switches to "OFF".

(f) Check that the SSB control switch is at CLOSE, the BTB control switches are at NORM, the GCB magnetic indicators display cross-line, the BTB magnetic indicators display in-line and the fault indicators on the front of all four control and protection units (CPUs) display 'all black' (no faults).

(g) Check that the 28 V supply switch on the dormant circuit test set is set to OFF and that all other switches on the test set are set to position 1.

(2) Test

(a) Using the appropriate cable loom and connector supplied therewith, connect the test set to the connector on the front of No.1 CPU.

NOTE: The 28 V d.c. external supply connector on the test set is not used for dormant circuit tests.

(b) Carry out the applicable operations detailed in Table 501 as applied to No.1 channel.

Disconnect the test set on completion.

NOTE: Switch numbers prefixed 'S' are test set switches. On the set, switch S1 is identified only by the number of engraved positions, i.e., positions 1-20; switches S2 to S7 are identified by corresponding engravings, i.e., SW2 to SW7. The 'VOLTS' readings are those registered on the test set voltmeter.

(c) Repeat operations (a) and (b) as applied to Nos.2, 3 and 4 CPUs and Nos.2, 3 and 4 channels, in turn.

(3) Conclusion

(a) Refit the panels opened in operation (1)(c).

(b) Remove the warning placard placed in operation (1)(b) and switch off and disconnect electrical ground power as detailed in 24-41-00.

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
1. CPU Internal Power Supplies:				
(1) Set 28 V supply switch on test set to "ON" and check that the GENERATOR ROTATING indicator lamp on the front of the CPU is lit	12(±1)	All black	Cross-line	In-line
(2) Set S1 to "2"	12(±1)	All black	Cross-line	In-line
(3) Set S1 to "3"	-			
Channels				
1 and 4	0	All black	Cross-line	In-line
2 and 3	12(±1)	All black	Cross-line	In-line
(4) Ensure that SSB control switch is set to "CLOSE"	-	-	-	-
(5) Set SSB control switch to "OPEN" (channels 2 and 3 only)	0	-	-	-
(6) Set SSB control switch to "CLOSE" (channels 2 and 3 only)	12(±1)	-	-	-
(7) Set S1 to "4"	12(±1)	All black	Cross-line	In-line
(8) Set S1 to "5"				
Channels				
1 and 4	0	All black	Cross-line	In-line
2 and 3	12(±1)	All black	Cross-line	In-line

OPERATION	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(9) Set SSB control switch to "OPEN" (channels 2 and 3 only)	0	-	-	-
(10) Set SSB control switch to "CLOSE" (channels 2 and 3 only)	12(±1)	-	-	-
(11) Set S1 to "6"	12(±1)	All black	Cross-line	In-line
NOTE: Operation (11) checks test set function only.				
2. Overspeed Circuit:				
(1) Set S1 to "7" and the GCB control switch to "ON"	6(±1)	All black	In-line	In-line
(2) Set S1 to "8" and S7 to "3"	6(±1)	OVERSPEED: white	Cross-line	In-line
(3) Set S7 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	6(±1)	All black	In-line	In-line
3. Average Voltage Sensing Circuit:				
(1) Set S1 to "9" and S2 to "2"	11(±2)	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
4. High Phase Sensing Circuit:				
(1) Set S2 to "1"	6(±1)	All black	In-line	In-line
(2) Set S1 to "10" and S2 to "2"	11(±2)	All black	In-line	In-line
5. Current Limit:				
(1) Set S2 to "1"	6(±1)	All black	In-line	In-line
(2) Set S1 to "11" and S2 to "2"	11(±2)	All black	In-line	In-line
6. Underspeed Circuit:				
(1) Set S2 to "1", S1 to "12" and S7 to "2"	0	All black	Cross-line	In-line
(2) Set S3 to "2" and S7 to "1"	0	UNDER-VOLTAGE: white	Cross-line	Cross-line then In-line
(3) Set S3 to "1", select "OFF" and then "ON" (reset) at the GCB control switch and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
7. Real Load Deficit Circuit:				
(1) Set S1 to "13" and S2 to "2"	0	REAL LOAD DEFICIT: white	In-line	Cross-line after 7(±3) s

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(2) Set S2 to "1" and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
8. Over-excitation (Over-voltage) Circuit:				
(1) Set S1 to "14" and S2 to "2"	0	OVER-VOLTAGE: white	Cross-line	Cross-line
(2) Set S2 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
9. Under-excitation (Under-voltage) Circuit:				
(1) Set S1 to "15" and S3 to "2"	0	UNDER-VOLTAGE: white	Cross-line	Cross-line then In-line
(2) Set S3 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the	0	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
INDICATOR RESET switch on the front of the CPU				
10. Current Unbalance Sensing Circuit:				
(1) Set S1 to "16" and check that the indicator lamp on test set is not lit	-	-	-	-
(2) Set S2 to "2" and then S4 to "2"	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
NOTE: There is a delay between the operation and the fault display.				
(3) Set S2 and S4 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, select "RESET" and then "NORM" at the BTB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(4) Set S1 to "17" and check that the indicator lamp on test set is not lit	-	-	-	-
(5) Repeat operation (2)	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
(6) Repeat operation (3)	0	All black	In-line	In-line
(7) Set S1 to "18" and check that the indicator lamp on test set is not lit	-	-	-	-
(8) Repeat operation (2)	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
(9) Repeat operation (3)	0	All black	In-line	In-line
11. Overcurrent Sensing Circuit:				
(1) Set S1 to "19", set S2 and S5 to "2", and then set S4 to "2"	0	BUSBAR: white	Cross-line after BTB	Cross-line after 6(±2) s

NOTE: There is a delay between the operation and the fault display.

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(2) Set S2, S4 and S5 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, select "RESET" and then "NORM" at the BTB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
12. Generator Feeder Fault Circuit:				
(1) Set S1 to "20" and check that the indicator lamp on test set is not lit	-	-	-	-
(2) Set S2 to "2"	0	GENERATOR FEEDER: white	Cross-line	In-line
(3) Set S2 to "1", S1 to "1" and actuate the INDICATOR RESET switch on the front of the CPU,	0	All black	Cross-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
then set 28 V supply switch on test set to "OFF"				

Dormant Circuit Test
Table 501

J. Emergency Generation Functional Test - Using Hydraulic Ground Power

CAUTION: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THIS TEST.

(1) Prepare

(a) Check that all a.c. supplies are inhibited and that d.c. power is switched off.

(b) Open circuit breaker panel 1-213 to permit observation of the 'power on' neon indicator lamps that are mounted together on a panel at the end of shelf 12-215 and identified in Table 502.

NEON LAMP	'POWER ON' INDICATION
1X233	No.1 engine relight busbar
2X233	No.2 engine relight busbar
3X233	No.3 engine relight busbar
4X233	No.4 engine relight busbar

NEON LAMP	'POWER ON' INDICATION
X232	Emergency generator

Neon Indicator Lamps on Panel at End of Shelf 12-215
Table 502

(c) Open circuit breaker panels 2-213 and 4-213 to permit observation of the neon indicator lamps that are mounted on the inner face of each panel and identified in Table 503.

NEON LAMP	PANEL	'POWER ON' INDICATION
1X136	2-213	No.1 a.c. essential busbar
2X136	2-213	No.2 a.c. essential busbar
3X136	4-213	No.3 a.c. essential busbar
4X136	4-213	No.4 a.c. essential busbar

Neon Indicator Lamps on Panels 2-213 and 4-213
Table 503

(d) Remove the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00) to permit access to the emergency generator control and protection unit (X201)on shelf 5-243.

(e) Make available electrical ground power as detailed in 24-41-00.

(f) Connect and supply ground hydraulic power to the green hydraulic system (Ref. Chap.29).

(2) Test

(a) Set BATT A and BATT B control switches to "ON" and check that the associated 'battery isolate' magnetic indicators

change from cross-line to in-line. Check also that the d.c. essential/main split magnetic indicators display in-line.

(b) Ensure that the EMERG RELIGHT BUSBAR selector switch on the engine starting panel (18-214) is set to OFF.

(c) Refer to Table 502 and check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are lit.

(d) Refer to Table 503 and check that Nos.1, 2, 3 and 4 a.c. essential busbar 'power on' neon indicator lamps are lit.

(e) Set the AC FREQ/VOLTS selector switch on the electrical generating control panel to "EMERG PWR".

(f) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "EMERG"; Nos.1, 2, 3 and 4 AC ESS BUS captions must be illuminated.

(g) Set the emergency generator mode switch to "MANUAL" and check that the emergency generator commences running, by observing the voltage and frequency indications on the associated meters (approx. 115 V 400 Hz). Check also that -

g1) the emergency generator 'power on' neon indicator lamp is lit (Ref. Table 502),

g2) the emergency generator FAIL caption is not illuminated,

g3) Nos.1 and 2 AC ESS BUS captions are extinguished, but Nos.3 and 4 AC ESS BUS captions remain illuminated,

g4) an emergency generator load is indicated on the emergency generator kVA meter, and

g5) the emergency generator voltage and frequency indications are not fluctuating.

(h) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "NORM"; Nos.1, 2, 3 and 4 A/C ESS BUS captions must be extinguished.

NOTE: The following operations (i) to (n), inclusive, involve the use of switches, fitted at the front panel of the emergency generator control and protection unit, to test the generator trip function of the internal overvoltage protection and differential current protection circuits and to reset the fault indicators on the unit after operation. One of these switches (SW4) is of the push-button type, the remainder (SW1, SW2, SW3 and SW5) are microswitches which are operated by insertion of a suitable probe through the corresponding access hole.

(i) Locate switches SW4 and SW2 on the emergency generator control and protection unit and observe the emergency generator indicators on the electrical generating control panel. Press switches SW4 and SW2, both together, hold both depressed for a period of not less than 1.5 s, then release both switches. Check that -

i1) the emergency generator is de-excited, by observing that the voltage and frequency indicators full to zero,

i2) the emergency generator FAIL caption is illuminated, and

i3) the overvoltage fault indicator on the emergency generator control and protection unit displays OV.

(j) Press-to-test the emergency generator FAIL caption to initiate the generator reset facility of the emergency generator control and protection unit. Check that -

j1) the emergency generator FAIL caption is extinguished, and

j2) the output of the emergency generator is reinstated, by observing that the voltage and frequency indications are correct (approx. 115 V 400 Hz).

(k) Press and then release the overvoltage fault indicator reset switch SW1 on the emergency generator control and protection unit and check that the OV display disappears.

(l) Locate switches SW4 and SW3 on the emergency generator control and protection unit and observe the emergency generator indicators on the electrical generating control panel. Press switches SW4 and SW3 both together, then release both switches without delay. Check that -

l1) the emergency generator is de-excited, by observing that the voltage and frequency indications fall to zero,

l2) the emergency generator FAIL caption is illuminated, and

l3) the differential protection fault indicator on the emergency generator control and protection unit displays DP.

(m) Press-to-test the emergency generator FAIL caption to initiate the generator reset facility of the emergency generator control and protection unit. Check that -

m1) the emergency generator FAIL caption is extinguished, and

m2) the output of the emergency generator is reinstated, by observing that the voltage and frequency indications are correct (approx. 115 V 400 Hz).

(n) Press and then release the differential protection fault indicator reset switch SW5 on the emergency generator control and protection unit and check that the DP display disappears.

(o) Isolate Nos.1, 2, 3 and 4 engine relight busbars from main a.c. busbars supplies by tripping the circuit breakers listed below and fitting safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
NO.1 RELT NORM SUP	22-215	1X226	-
NO.2 RELT NORM	21-215	2X226	-

Printed in England

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
SUP			
NO.3 RELT NORM SUP	21-216	3X226	-
NO.4 RELT NORM SUP	22-216	4X226	-

(p) Refer to Table 502 and check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are extinguished.

(q) Refer to Table 502. Select positions "2", "4", "3" and "1", in turn, on the EMERG RELIGHT BUSBAR selector switch and check that as each busbar is selected, the correspondingly-numbered engine relight busbar 'power on' neon indicator lamp is lit.

(r) Set the EMERG RELIGHT BUSBAR selector switch to "OFF" and check that all four engine relight busbar 'power on' neon indicator lamps (Ref. Table 502) are extinguished.

(s) Set the emergency generator isolate switch to "ISOL" and then set the emergency generator mode switch to "AUTO". Check that the emergency generator ceases running, by observing that the voltage and frequency indications fall to zero, then reset the isolate switch to "NORM".

(3) Conclusion

(a) Remove the safety clips and reset the circuit breakers tripped in operation (2)(o). Check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are lit.

(b) Switch off and disconnect the ground hydraulic supply (Ref. Chap.29).

(c) Switch off the ground power supply at source and place a warning placard on the ground

power rig forbidding any attempt to switch the ground supply on.

(d) Close and secure circuit breaker panels 1-213, 3-213 and 4-213.

(e) Refit the rear vestibule LH electronic racking forward and decor bulkheads (Ref. 25-71-00).

(f) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

R **ON A/C 007-007,

K. AC and DC Generation Master Warning Functional Test

CAUTION: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

NOTE: Checks of the master warning test facilities associated with main generator operation are contained in the functional test using main engines (Ref. para.L.).

(1) Prepare

(a) Open the engine bay doors as required to gain access to Nos.1, 2, 3 and 4 integrated drive generators (IDGs) (Ref. 71-00-00).

(b) Make all four CSD failure warning circuits inoperative by disconnecting the electrical connector from the oil low pressure warning switch at each IDG, i.e., connector 1X1-C (No.1 IDG), 2X1-C (No.2 IDG), 3X1-C (No.3 IDG) and 4X1-C (No.4 IDG).

(c) Isolate all four generator (GEN) failure warning indication circuits by tripping the following circuit breakers. Fit safety clips to the tripped circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
No.1 & 2 GEN FAIL WARN IND.	1-213	1X12	P9
No.3 & 4 GEN FAIL WARN IND.	3-213	4X12	E10

(d) Make available electrical ground power as detailed in 24-41-00.

NOTE: The settings/indications of controls and indicators checked at the following operation (e) are those usual upon satisfactory connection of a ground power supply to the main a.c. distribution system (ground power breaker (GPB) closed).

(e) Check that the electrical power distribution system is set for normal operation by ensuring that -

e1) the AC FREQ/VOLTS selector switch is set to GRND PWR and that the correct voltage and frequency are indicated on the a.c. voltmeter and frequency meter,

e2) the battery control switches are at OFF, the associated 'battery isolate' magnetic indicators display cross-line, the DC NORM/SPLIT control switch is at NORM, and the d.c. essential/main split magnetic indicators display in-line,

e3) the SSB control switch is at CLOSE and the SSB position magnetic indicator displays in-line,

e4) Nos.1, 2, 3 and 4 BTB control switches are at NORM and all four BTB position magnetic indicators display in-line,

e5) all four generator circuit breaker (GCB) position magnetic indicators and the auto shed breaker (ASB) position magnetic

indicator display cross-line,

e6) all four essential/main (NORM/EMERG) control switches are at NORM and the associated essential/main isolate magnetic indicators display in-line, and

e7) all four TRU control switches are at NORM.

(f) Open the forward underfloor service compartment door (123 AB) (Ref. 52-41-11) to permit access to 'A' battery charge controller (1P35) and 'B' battery charge controller (2P35), mounted on the top surface of the weather radar racking in the forward underfloor racking zone.

(2) Test

(a) On the electrical generating control panel, check that the GRND PWR AVAILABLE caption and the ISOL sections only of both BATT - FAIL/ISOL captions are illuminated, and that all other captions are extinguished.

(b) Set both battery control switches to "ON" and check that the ISOL sections of both BATT - FAIL/ISOL captions are extinguished and the FAIL sections of both remain extinguished. Return both battery control switches to "OFF" and check that only the ISOL sections of both BATT - FAIL/ISOL captions are illuminated.

(c) Press the RECALL button on the master warning display panel; some master warning captions may be illuminated. Press the face of all captions on the master warning display panel that are illuminated and check that each is extinguished (warning cancelled).

(d) Press the face of the No.1 AC MAIN BUS caption and check that -

d1) the caption is illuminated,

d2) the amber ELEC caption on the master warning display panel is illuminated, and

d3) the audio warning (single-stroke gong) sounds.

(e) Release the face of the caption pressed in operation (d) and check that -

e1) the caption is extinguished, and

e2) the amber ELEC caption on the master warning display panel is extinguished.

(f) Repeat operations (d) and (e), in turn, as applied to each of the following captions:-

No.2 AC MAIN BUS

No.3 AC MAIN BUS

No.4 AC MAIN BUS

DC MAIN BUS

'A' BATT - FAIL/ISOL (the FAIL section must be illuminated)

'B' BATT - FAIL/ISOL (the FAIL section must be illuminated)

(g) Set No.1 BTB control switch to "TRIP". Check that -

g1) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are illuminated,

g2) the amber ELEC and the red ELEC captions on the master warning display panel are illuminated, and

g3) the audio warning (single-stroke gong) sounds.

(h) Return No.1 BTB control switch to "NORM". Check that -

h1) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are extinguished, and

h2) the amber ELEC and the red ELEC captions on the master warning display panel are extinguished.

(i) Repeat operations (g) and (h), in turn, as

applied to Nos.2, 3 and 4 BTB control switches.

(j) Trip the 'A' SYS MAIN U/VOLT UNIT SUP circuit breaker 1P13 on panel 15-215, map ref.A2. Check that -

j1) the DC MAIN BUS caption is illuminated, the amber ELEC caption on the master warning display panel is illuminated, and

j2) the audio warning (single-stroke gong) sounds.

(k) Reset the 'A' SYS MAIN U/VOLT UNIT SUP circuit breaker 1P13 on panel 15-215, map ref.A2. Check that -

k1) the DC MAIN BUS caption is extinguished, and

k2) the amber ELEC caption on the master warning display panel is extinguished.

(l) Locate the test button on the 'A' battery charge controller (1P35) and observe the associated BATT - FAIL/ISOL caption. Press, and hold depressed, the test button. Check that after a period not exceeding 6 s, the FAIL section of the associated caption is illuminated, the amber ELEC caption on the master warning display panel is illuminated, and the audio warning (single-stroke gong) sounds. Release the test button and check that the FAIL section of the associated BATT - FAIL/ISOL caption and the amber ELEC caption are extinguished.

(m) Repeat operation (l) as applied to the 'B' battery charge controller (2P35).

(n) Press the RECALL button on the master warning display panel and ensure that the red ELEC and amber ELEC captions remain extinguished; some other master warning captions may be illuminated. Press the face of all other captions on the master warning panel that are illuminated and check that each is extinguished (warning cancelled).

(o) Press the face of No.1 AC ESS BUS caption and check that -

o1) the caption is illuminated,

o2) the red ELEC caption on the master warning display panel is illuminated, and

o3) the audio warning (single-stroke gong) sounds.

(p) Release the face of the caption pressed in operation (o) and check that -

p1) the caption is extinguished, and

p2) the red ELEC caption on the master warning display panel is extinguished.

(q) Repeat operations (o) and (p), in turn, as applied to each of the following captions:-

No.2 AC ESS BUS

No.3 AC ESS BUS

No.4 AC ESS BUS

'A' system DC ESS BUS

'B' system DC ESS BUS

(r) Trip the 'A' ESS U/VOLT UNIT SUP circuit breaker 1P26 on panel 1-213, map ref.M8. Check that -

r1) the 'A' system DC ESS BUS caption is illuminated,

r2) the red ELEC caption on the master warning display panel is illuminated, and

r3) the audio warning (single-stroke gong) sounds.

(s) Reset the 'A' ESS U/VOLT UNIT SUP circuit breaker 1P26 on panel 1-213, map ref.M8. Check that -

s1) the 'A' system DC ESS BUS caption is extinguished, and

s2) the red ELEC caption on the master warning display panel is extinguished.

(t) Trip the 'B' ESS U/VOLT UNIT SUP circuit breaker 2P26 on panel 3-213, map ref.E12. Check that -

t1) the 'B' system DC ESS BUS caption is illuminated,

t2) the red ELEC caption on the master warning display panel is illuminated, and

t3) the audio warning (single-stroke gong) sounds.

(u) Reset the 'B' ESS U/VOLT UNIT SUP circuit breaker 2P26 on panel 3-213, map ref.E12. Check that -

u1) the 'B' system DC ESS BUS caption is extinguished, and

u2) the red ELEC caption on the master warning display panel is extinguished.

(v) Press the face of the emergency generator O/HEAT caption and check that -

v1) the caption is illuminated,

v2) the red ELEC caption on the master warning display panel is illuminated, and

v3) the audio warning (single-stroke gong) sounds.

(w) Release the face of the emergency generator O/HEAT caption and check that -

w1) the caption is extinguished, and

w2) the red ELEC caption on the master warning display panel is extinguished.

(x) Press the face of the caption CSD 1 and check that -

x1) the caption is illuminated,

x2) the amber ELEC caption on the master warning display panel is illuminated, and

x3) the audio warning (single-stroke gong) sounds.

(y) Release the face of the caption pressed in operation (x) and check that -

y1) the caption is extinguished, and

y2) the amber ELEC caption on the master warning display panel is extinguished.

(z) Repeat operations (x) and (y), in turn, as applied to each of the following captions:-

CSD 2

CSD 3

CSD 4

(aa) Set both battery control switches to "OFF".

(ab) Remove the safety clips and reset the circuit breakers tripped in operation (1)(c). Ensure that the captions GEN 1, GEN 2, GEN 3 and GEN 4 are illuminated.

(3) Conclusion

(a) Set the ground power control switch on the electrical generating control panel to "TRIP" and release it.

(b) At each IDG, reconnect the connector disconnected in operation (1)(b), ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock each connector (Ref. Wiring Diagram Manual, 20-42-48).

(c) Set the ground power control switch on the electrical generating control panel to "CLOSE" and release it. Ensure that the captions CSD 1, CSD 2, CSD 3 and CSD 4 are illuminated.

(d) Close the engine bay doors (Ref. 71-00-00).

(e) Close the forward underfloor service compartment door (123 AB) (Ref. 52-41-11).

(f) Switch off and disconnect electrical ground power as detailed in 24-41-00.

L. AC Generation Functional Test - Using Main Engines

NOTE: On the electrical generating control panel, the abbreviation CSD (constant speed drive) is used on associated control and indication equipment to identify the transmission component of the IDG (integrated drive generator) in each main generation channel.

(1) Prepare

(a) Ensure that the aircraft power unit installation and systems are cleared and safe for the ground running of all four engines to be carried out (Ref. Chap.71).

(b) Ensure that the integrated drive generator (IDG) fitted to each engine has been cleared for running (Ref. 24-11-11, Inspection/Check) and that the transmission (constant speed drive) is engaged.

(c) Make available electrical ground power as detailed in 24-41-00.

NOTE: The settings/indications of controls and indicators checked at the following operation (d) are those usual upon satisfactory connection of a ground power supply to the main a.c. distribution system (ground power breaker (GPB) closed).

(d) Check that the electrical power distribution system is set for normal operation by ensuring that -

d1) the AC FREQ/VOLTS selector switch is set to GRND PWR and that the correct voltage and frequency are indicated on the a.c. voltmeter and frequency meter,

d2) the battery control switches are at OFF, the associated 'battery isolate' magnetic indicators display cross-line, the DC NORM/SPLIT control switch is at NORM, and the essential/main split magnetic indicators display in-line,

d3) the SSB control switch is at CLOSE and the SSB position magnetic indicator

displays in-line,

d4) Nos.1, 2, 3 and 4 BTB control switches are at NORM and all four BTB position magnetic indicators display in-line,

d5) all four generator circuit breaker (GCB) position magnetic indicators and the auto shed breaker (ASB) position magnetic indicator display cross-line,

d6) all four essential/main (NORM/EMERG) control switches are at NORM and the associated essential/main isolate magnetic indicators display in-line, and

d7) all four TRU control switches are at NORM.

(e) Ensure that all four generator control switches are set to ON.

(f) In readiness for engine starting, set BATT A and BATT B control switches to "ON", checking that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(g) Before engine starting, check that -

g1) the generator failure captions GEN 1, GEN 2, GEN 3 and GEN 4 are illuminated and all four generator circuit breaker (GCB) position magnetic indicators display cross-line, and

g2) the constant speed drive (CSD) failure captions CSD 1, CSD 2, CSD 3 and CSD 4 are illuminated.

(2) Test

CAUTION: IF A CSD (CONSTANT SPEED DRIVE) FAILURE CAPTION REMAINS ILLUMINATED AFTER THE ASSOCIATED ENGINE HAS RUN UP TO A SPEED OF 62 PER CENT N2 OR ABOVE, ABNORMAL OPERATION OF THE IDG IS INDICATED. THE CSD DISCONNECT SWITCH MUST THEN BE OPERATED TO THE "DISC" POSITION TO EFFECT DISENGAGEMENT OF THE IDG TRANSMISSION.

DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

(a) Start and run No.1 engine at a speed above 62 per cent N2 noting the procedures to be carried out if excessive CSD OIL INLET temperature is indicated during the engine run (Ref. 71-00-00). Check that -

a1) the associated CSD failure caption is extinguished,

a2) the associated GEN failure caption is extinguished, and

a3) the associated GCB position magnetic indicator displays in-line.

(b) With No.1 engine running at a speed above 62 per cent N2, check that the auto shed breaker (ASB) position magnetic indicator displays in-line.

(c) Repeat operation (a), in turn, for Nos.2, 3 and 4 engines. If the automatic paralleling of a generator is not effected, i.e., the associated CSD failure caption is extinguished but the associated GEN failure caption remains illuminated and the associated GCB position magnetic indicator remains cross-line, assist paralleling as follows:-

c1) Identify the generator with the lowest frequency identification by using the AC FREQ/VOLTS selector switch, then

c2) momentarily press the P/ASSIST push-switch associated with the generator giving the lowest frequency indication.

<u>NOTE</u>: Operation of a P/ASSIST push-switch affects the CSD (IDG transmission) output speed and momentarily increases the generator frequency by approximately 3 Hz. This permits automatic paralleling where previously the generators were either running synchronized but at incorrect phase angle, or

their frequency difference was greater than 4 Hz.

(d) Where the operation of a P/ASSIST switch has been necessary to bring a generator into parallel operation, record the frequency of each generator as indicated on the frequency meter, by holding Nos.1, 2, 3 and 4 generator control switches, in turn, at "TEST" with the AC FREQ/VOLTS selector switch set to the corresponding generator position. If a difference in frequency greater than 4 Hz is registered between any two generators, the associated CSD(s) must be adjusted.

NOTE: If CSD (IDG transmission) adjustment is necessary, refer to 24-11-00, Main Generator Drive, Adjustment/Test.

(e) Set the AC FREQ/VOLTS selector switch to "GEN 1", "GEN 2", "GEN 3" and "GEN 4", in turn, and check that the nominal voltage and frequency (approx. 115 V 400 Hz) are displayed on the voltmeter and frequency meter at each switch position.

(f) Check that the paralleling of Nos.1, 2, 3 and 4 main generation channels is established by observing that -

f1) Nos.1, 2, 3 and 4 bus-tie breaker (BTB) position magnetic indicators display in-line, and

f2) Nos.1, 2, 3 and 4 AC MAIN BUS and Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished.

(g) Note the reading in kilowatts indicated on Nos.1, 2, 3 and 4 KW/KVAR meters. Check that any difference in load sharing does not exceed 6 kW.

(h) Press the PUSH FOR KVAR push-switch and note the reading on Nos.1, 2, 3 and 4 KW/KVAR meters. Check that any difference in load sharing, so indicated, does not exceed 4 kVAR.

(i) Check that the IDG oil temperature is indicated on the INLET and DIFF scales of the correspondingly-numbered CSD oil temperature

indicators and that the overheat warning lamp on the front of each indicator is not lit.

NOTE: Under ground running conditions, the oil inlet temperature and differential temperature will be approximately 80 deg C and 15 deg C respectively. These values will vary according to the generator load and the ambient temperature.

(j) Press the face of the caption GEN 1 and check that -

j1) the caption is illuminated,

j2) the amber ELEC caption on the master warning display panel is illuminated, and

j3) the audio warning (single-stroke gong) sounds.

(k) Release the face of the caption pressed in operation (j) and check that -

k1) the caption is extinguished, and

k2) the amber ELEC caption on the master warning display panel is extinguished.

(l) Repeat operations (j) and (k), in turn, as applied to each of the following captions:-

GEN 2

GEN 3

GEN 4

R **ON A/C 007-007,

NOTE: The following operations (m) to (s), inclusive, are optional. They provide a convenient method of checking operation of the emergency generator automatic start and auto-shed breaker (ASB) control circuits and the 26 V a.c. 'A' and 'B' main busbar load shedding control circuits.

(m) Check that the emergency generator mode switch

is at AUTO and that the emergency generator SELECTED caption is not illuminated.

(n) Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG". Check that the emergency generator starts running, i.e., the SELECTED caption is illuminated and the FAIL caption is not illuminated. Check also that -

n1) Nos. 2 and 3 AC ESS BUS captions are extinguished, indicating that the output of the emergency generator is connected to the associated busbars via the 'A' and 'B' system emergency busbars,

n2) the emergency generator voltage and frequency are correct (approx. 115 V 400 Hz) and not fluctuating, and

n3) the 'A' and 'B' system 26 V a.c. main busbars are shed, by observing that the power supply failure warning flag is visible on the blue system quantity indicator and the yellow system quantity indicator on the hydraulic management panel.

(o) Return Nos.2 and 3 essential/main (NORM/EMERG) control switches to "NORM". Check that the emergency generator SELECTED caption remains illuminated and the emergency generator continues running. Check also that power is restored to the 'A' and 'B' system 26 V a.c. main busbars, by observing that the power supply failure warning flag has disappeared from the blue hydraulic system quantity indicator and the yellow hydraulic system quantity indicator.

(p) Set the emergency generator mode switch to GRD BY-PASS and check that the emergency generator SELECTED caption is extinguished and the emergency generator ceases running.

(q) Shut down No.1 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2, the emergency generator does not commence running, i.e., the SELECTED caption is not illuminated.

(r) Shut down No.2 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2 -

r1) the ASB position magnetic indicator changes from in-line to cross-line, and

r2) the emergency generator SELECTED caption is illuminated, followed by illumination of the FAIL caption after a short period.

NOTE: The pressurizing supply for the green hydraulic system is provided by No.1 and/or No.2 engine-driven pump(s). Thus, with shut-down of both Nos.1 and 2 engines, power to sustain operation of the emergency generator will be lost. Residual pressure in the system will, however, enable the emergency generator to start and run at normal operating speed for a short period, after which the decay of system pressure will result in generator run-down and illumination of the FAIL warning caption.

(s) Set the emergency generator mode switch to "AUTO", then set the emergency generator isolate switch to "ISOL". Return the emergency generator isolate switch to "NORM" and check that the SELECTED and FAIL captions are extinguished.

(3) Conclusion

(a) If not already effected, shut down Nos.1 and 2 engines (Ref. Chap.71).

(b) Shut down Nos.3 and 4 engines (Ref. Chap.71).

(c) Set BATT A and BATT B control switches to "OFF".

(d) Switch off and disconnect electrical ground power as detailed in 24-41-00.

4. Electrical Bonding

(1) The requirements for electrical bonding are given in 20-27-11.

(2) The verification of electrical bonding is necessary when -

(a) existing bonding connections have been disturbed by maintenance procedures, or

(b) there is reason to suspect contamination, corrosion or damage, or

(c) a malfunction (e.g., radio interference) is being investigated.

R **ON A/C 001-006,

GENERAL - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00, SERVICING.

OBSERVE THE HYDRAULIC FLUID SAFETY PRECAUTIONS DETAILED IN 29-00-00.

1. General

This topic comprises an Operational Test and a Functional Test of the electrical power system. Leading information concerning electrical bonding is also included (Ref. para.4.).

The appropriate System Test, because of its length and complexity, is sub-divided and covered in the associated sub-systems.

The Operational Test (Ref. para.2.) checks the operation of certain controls that are not normally operated on each flight. This test is usually all that is required after routine servicing).

The Functional Test (Ref. para.3.) checks control and protection circuits in which failure may not be apparent under normal operating conditions. It is divided, for convenience of application, into a series of tests identified under separate sub-headings as follows:-

Emergency Generation Preliminary Functional Test

Emergency Generator Overheat Indication Functional Test

26 V 400 Hz AC Generation Functional Test

'A' and 'B' Avionics 115 V 400 Hz AC Busbars Functional Test

115/26 V AC Standby Inverter Supplies and Control Functional Test

DC Essential/Main Split - AC Undervolt Control Functional Test

Main Generation Dormant Circuits Functional Test

Emergency Generation Functional Test - Using Hydraulic Ground Power

AC and DC Generation Master Warning Functional Test

AC Generation Functional Test - Using Main Engines

At the conclusion of individual tests certain operations, e.g., switching off electrical ground power, may be omitted provided that a sequential test validates the omission.

2. Operational Test

A. Prepare

(1) Make available electrical ground power as detailed in 24-41-00.

B. Test

(1) Set BATT A and BATT B control switches to "BATT ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(2) Set BATT A control switch to "ESS/MAIN SPLIT" and check that the associated essential/main split magnetic indicator changes from in-line to cross-line. Return the switch to "BATT ON" and check that the associated essential/main split magnetic indicator returns to in-line.

(3) Repeat operation (2) as applied to BATT B.

(4) Set the split system breaker (SSB) control switch to "OPEN" and check that both SSBs open, by observing that all four AC MAIN BUS captions are illuminated. Check also that the SSB position magnetic indicator changes from in-line to cross-line.

NOTE: The AC ESS BUS captions will also be illuminated.

(5) Return the SSB control switch to "CLOSE" and check that the four AC MAIN BUS captions are extinguished and the SSB position magnetic indicator changes from cross-line to in-line.

(6) Set No.1 bus-tie breaker (BTB) control switch to "TRIP" and check that -

(a) the correspondingly-numbered BTB position

magnetic indicator changes from in-line to cross-line,

(b) the correspondingly-numbered essential/ main isolate magnetic indicator changes from in-line to cross-line, and

(c) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are illuminated.

(7) Return No.1 BTB control switch to "NORM" and check that -

(a) the correspondingly-numbered BTB position magnetic indicator changes from cross-line to in-line,

(b) the correspondingly-numbered essential/ main isolate magnetic indicator changes from cross-line to in-line, and

(c) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are extinguished.

(8) Repeat operations (6)and (7) as applied to Nos.2, 3 and 4 BTB control switches.

(9) Set each transformer rectifier (TRU) control switch, in turn, to "ISOL" and check that each TRU ammeter indication falls to zero as the associated ISOL setting is made. When all four TRUs are isolated, check that the DC MAIN BUS caption is illuminated and both 'A' and 'B' essential/main split magnetic indicators display cross-line.

NOTE: Isolation of the d.c. main busbar is initiated by undervolt detectors that have an inverse time delay and, normally, d.c. main busbar isolation will occur between 2 and 10 s after the last TRU is switched off.

(10) With the four TRUs isolated, set BATT A control switch to "BATT OFF" and check that 'A' system DC ESS BUS caption is illuminated.

(11) Return BATT A control switch to "BATT ON" and check that the 'A' system DC ESS BUS caption is extinguished.

(12) Repeat operations (10) and (11) as applied to BATT B.

(13) Return all four TRU control switches to "NORM" and check that the DC MAIN BUS caption is extinguished and both 'A' and 'B' essential/ main split magnetic indicators return to in-line.

(14) Set the emergency generator mode switch to "MANUAL" and check that the SELECTED and FAIL captions are illuminated.

(15) Set the emergency generator isolate switch to "ISOL" and check that the SELECTED and FAIL captions are extinguished. Return the switch to "NORM" and check that the SELECTED and FAIL captions are again illuminated.

(16) Set the emergency generator mode switch to "GRD BY-PASS" and check that the SELECTED and FAIL captions are illuminated.

(17) Repeat operation (15).

(18) Set the emergency generator isolate switch to "ISOL" and check that the SELECTED and FAIL captions are extinguished.

(19) Return the emergency generator mode switch to "AUTO".

(20) Return the emergency generator isolate switch to "NORM" and check that the SELECTED and FAIL captions are not illuminated.

(21) Set BATT A and BATT B control switches to "BATT OFF" and check that the associated 'battery isolate' magnetic indicators change from in-line to cross-line and that the 'A' system and 'B' system BATT ISOLATE captions are illuminated.

C. Conclusion

(1) Switch off and disconnect electrical ground power as detailed in 24-41-00.

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3. Functional Test

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED

TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Decade resistance boxes, range 100 - 200 ohm (two), required for Emergency Generator Overheat Indication Functional Test	-
Test lamps, 28 V, required (four) for 26 V 400 Hz AC Generation Functional Test, and (one) for 115/26 V AC Standby Inverter Supplies and Control Functional Test	-
Neon test indicators, 115 V (two), required for 'A' and 'B' Avionics 115 V 400 Hz AC Busbars Functional Test	-
Dormant circuit test set, required for Main Generation Dormant Circuits Functional Test	TE.5002.000
Throttle control system test set, required for Emergency Generation Preliminary Functional Test	QT6A16-24
Precision-grade a.c. voltmeter, range 110 - 125 V a.c., required for 115/26 V AC Standby Inverter Supplies and Control Functional Test	-
Precision-grade frequency meter, range 350 - 450 Hz, required for 115/26 V AC Standby Inverter Supplies and Control Functional Test	-

DESCRIPTION	PART NO.
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN), required for DC Essential/Main Split - AC Undervolt Control Functional Test	-

B. Emergency Generation Preliminary Functional Test

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN AND THE GREEN HYDRAULIC SYSTEM MUST NOT BE PRESSURIZED DURING THIS PRELIMINARY TEST.

CAUTION: SUBSEQUENT TEST PROCEDURES REQUIRE THE TRIPPING OF CIRCUIT BREAKERS, TO ESTABLISH LEFT-HAND AND RIGHT-HAND WEIGHT SWITCH OPERATED RELAYS IN THE 'IN-FLIGHT' POSITION. CARE MUST BE TAKEN TO ENSURE THAT ALL SERVICES ADVERSELY AFFECTED BY THIS CONDITION ARE PREVIOUSLY ISOLATED (REF. 7-11-00).

NOTE: The following test procedures include operation of the engine speed unit (ESU) internal relay in the emergency generator automatic start and auto shed breaker (ASB) control circuits. The required input of engine speed signals to the ESU is provided by the throttle control system test set connected and operated as detailed below.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Trip the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Fit safety clips to the tripped circuit breakers.

(c) Gain access to the engine control amplifiers (throttle amplifiers) mounted on shelves 6-215 and 8-215 by removing the appropriate panels from the flight compartment left-hand racking.

(d) Locate No.1 engine main control amplifier (1K20) mounted on shelf 8-215, and No.2 engine main control amplifier (2K20) mounted on shelf 6-215.

(e) On the pilots' roof panel, 4-211, ensure that -

e1) No.1 engine and No.2 engine AUTO-IGNITION control switches are set to OFF,

e2) No.1 engine and No.2 engine HP VALVE control switches are set to SHUT, and

e3) No.1 engine and No.2 engine THROTTLE MASTER switches are set to OFF.

(f) Place a warning placard in the flight compartment forbidding alteration of the switch settings specified in paragraphs e1), e2) and e3).

NOTE: The setting of Nos.1 and 2 engine throttle levers is not significant.

(2) Test

(a) Connect the throttle control system test set cable 2 between connector socket PL 2 on the test set and connector socket SKT 2 on the front of No.1 engine main control amplifier (1K20).

NOTE: The following test procedures do not require the setting of any control on the test set to a particular position; any setting will provide a satisfactory test condition.

(b) Ensure that the emergency generator isolate switch is at NORM. Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator SELECTED and FAIL captions are illuminated.

(c) Observe No.1 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, checking that the pointer on No.1 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(d) With the reading on No.1 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that -

d1) the emergency generator SELECTED and FAIL captions are extinguished, and

d2) the ASB position magnetic indicator changes from cross-line to in-line.

(e) Trip the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and check that when the reading on No.1 engine HP RPM (N2) indicator falls below approximately 58 per cent N2, -

e1) the emergency generator SELECTED and FAIL captions are illuminated, and

e2) the ASB position magnetic indicator changes from in-line to cross-line.

(f) Fit a safety clip to the circuit breaker tripped in operation (e).

(g) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.1 engine main control amplifier and reconnect it to connector socket SKT 2 on the front of No.2 engine main control amplifier (2K20).

(h) Observe No.2 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(i) With the reading on No.2 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that -

i1) the emergency generator SELECTED and FAIL captions are extinguished, and

i2) the ASB position magnetic indicator changes from cross-line to in-line.

(j) Set No.1 essential/main (NORM/EMERG) control switch to "EMERG" and check that the correspondingly-numbered essential/ main isolate magnetic indicator changes from in-line to cross-line and that the correspondingly-numbered AC ESS BUS caption is illuminated. Check also that the emergency generator SELECTED and FAIL captions are illuminated.

(k) Return No.1 essential/main (NORM/EMERG) control switch to "NORM" and check that the correspondingly-numbered essential/ main isolate magnetic indicator returns to in-line, and that the correspondingly-numbered AC ESS BUS caption and the emergency generator SELECTED and FAIL captions are extinguished.

(l) Repeat operations (j) and (k) as applied to Nos.2, 3 and 4 essential/main (NORM/ EMERG) control switches.

(m) Trip the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, and check that when the reading on No.2 engine HP RPM (N2) indicator falls below approximately 58 per cent N2 -

m1) the emergency generator SELECTED and FAIL captions are illuminated, and

m2) the ASB position magnetic indicator changes from in-line to cross-line.

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(n) Fit a safety clip to the circuit breaker tripped in operation (m).

(o) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10 and fit a safety clip.

(p) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.2 engine main control amplifier and from connector socket PL 2 on the test set. Remove the test set, fit the captive protection caps to connector sockets SKT 2 on Nos.1 and 2 engine main control amplifiers

and refit the panels removed to gain access to shelves 6-215 and 8-215.

(q) Remove the safety clips and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Remove the warning placard placed in operation (1)(f).

(r) Establish the left-hand and right-hand weight switch operated relays in the 'in-flight' position by tripping the following circuit breakers; ensure that all services adversely affected by this condition are isolated (Ref. 7-11-00). Fit safety clips to the tripped circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
LH UC WEIGHT SW & DOWNLOCK 'B' SYS SUP	3-213	G293	B8
RH UC WEIGHT SW 'B' SYS SUP	3-213	G294	B9

(s) Set the emergency generator mode switch to "AUTO".

(t) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the emergency generator SELECTED and FAIL captions are illuminated.

(u) Establish the left-hand and right-hand weight switch operated relays in the 'ground' position by removing the safety clips and resetting the two circuit breakers tripped in operation (r) and check that the SELECTED and FAIL captions remain illuminated. Ensure that the

weight switch relay controlled services isolated in accordance with the provisions of operation (r) are reinstated as required.

(v) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and remain extinguished.

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(n) Set the emergency generator isolate switch to "ISOL" and the mode switch to "AUTO", then set the isolate switch to "NORM" and check that the emergency generator SELECTED and FAIL captions are extinguished.

(p) Observe No.2 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(q) With the reading on No.2 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that the emergency generator FAIL and SELECTED captions remain extinguished.

(r) Repeat operation (j).

(s) Return No.1 essential/main (NORM /EMERG) control switch to "NORM" and check that the correspondingly numbered essential/main isolate magnetic indicator returns to in-line and the correspondingly numbered AC ESS BUS caption is extinguished. Check that the emergency generator SELECTED and FAIL captions remain illuminated.

(t) Trip the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, and check that when the reading on No.2 engine HP RPM (N2) indicator falls below approx-

imately 58 per cent N2, the emergency generator SELECTED and FAIL captions remain illuminated.

(u) Fit a safety clip to the circuit breaker tripped in operation (t).

(v) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and remain extinguished.

(w) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(x) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.2 engine main control amplifier and from connector socket PL 2 on the test set. Remove the test set, fit the captive protection caps to connector sockets SKT 2 on Nos.1 and 2 engine main control amplifiers and refit the panels removed to gain access to shelves 6-215 and 8-215.

(y) Remove the safety clips and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Remove the warning placard placed in operation (1)(f).

(z) Establish the left-hand and right-hand weight switch operated relays in the 'in-flight' position by tripping the following circuit breakers; ensure that all services adversely affected by this condition are isolated (Ref. 7-11-00). Fit safety clips to the tripped circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
LH UC WEIGHT SW & DOWNLOCK 'B' SYS SUP	3-213	G293	B8

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
RH UC WEIGHT SW 'B' SYS SUP	3-213	G294	B9

(aa) Check that the emergency generator mode switch is set to AUTO. Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the emergency generator SELECTED and FAIL captions are illuminated.

(ab) Establish the left-hand and right-hand weight switch operated relays in the 'ground' position by removing the safety clips and resetting the two circuit breakers tripped in operation (z) and check that the SELECTED and FAIL captions remain illuminated. Ensure that the weight switch relay controlled services isolated in accordance with the provisions of operation (z) are reinstated as required.

(ac) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and remain extinguished.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

C. Emergency Generator Overheat Indication Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER

GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9, and fit safety clips.

(b) Gain access to the emergency generator by opening access door 153 DB (Ref. 52-41-41) and disconnect the electrical connector (X200-A) from the emergency generator.

(c) Connect a decade resistance box between pins A and B of the emergency generator 'free' connector (X200-A) and another decade resistance box between pins G and H. Set each box at 100 ohm.

(d) Make available electrical ground power as detailed in 24-41-00.

(e) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10.

(2) Test

(a) Set the emergency generator mode switch to "GRD BY-PASS" and check that the SELECTED and FAIL captions are illuminated.

(b) Progressively increase the resistance on the resistance box connected between pins A and B and check that the emergency generator O/HEAT caption and the master warning red ELEC caption are illuminated when the resistance is at a setting within the range 162 to 167 ohm. Reset the resistance box to 100 ohm and check that the emergency generator O/HEAT caption and the master warning red ELEC caption are extinguished.

(c) Repeat operation (b) as applied to the resistance box connected between pins G and H.

(d) Set the emergency generator isolation switch to "ISOL" and the mode switch to "AUTO". Check that the SELECTED and FAIL captions are extinguished, then set the isolation switch to "NORM".

(3) Conclusion

(a) Trip the EMER GEN AUTO CONT circuit breaker

X212 on panel 3-213, map ref.G10, and fit a safety clip.

(b) Disconnect and remove the decade resistance boxes and reconnect the electrical connector to the emergency generator, ensuring that the mating surfaces are clean and undamaged. Refit the access door removed in operation (1)(b).

(c) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9.

(d) Switch off and disconnect electrical ground power as detailed in 24-41-00.

D. 26 V 400 Hz AC Generation Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Isolate the 26 V a.c. main and essential busbars by tripping the circuit breakers listed below. Fit safety clips to the tripped circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
'A' SYS 26 V AC TRANS SUP	2-213	1X131	D18
'B' SYS 26 V AC TRANS SUP	4-213	2X131	B13

(d) Gain access to the 26 V 'A' and 'B' main busbars on panels 13-215 and 13-216 respectively and the 26 V 'A' and 'B' essential busbars on panels 2-213 and 4-213 respectively by opening these circuit breaker panels.

(e) Connect 28 V test lamps, one between each 26 V a.c. busbar and earth; test lamp connection points, suitable for each busbar, are as follows:-

'A' main busbar: Terminal 1 of circuit breaker D81 on panel 13-215, map ref.D1.

'B' main busbar: Terminal 1 of circuit breaker H1010 on panel 13-216, map ref.D19.

'A' essential busbar: Terminal 1 of circuit breaker 1F78 on panel 2-213, map ref.A2.

'B' essential busbar: Terminal 1 of circuit breaker D211 on panel 4-213, map ref.E3.

(f) Remove the safety clips and reset the circuit breakers tripped in operation (c).

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Check that the four test lamps connected in operation (1)(e) are all lit.

(b) Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG" and check that the test lamps connected to the 26 V a.c. 'A' and 'B' busbars go out.

(c) Return Nos.2 and 3 essential/main (NORM/EMERG) control switches to "NORM" and check that the test lamps connected to the 26 V a.c. 'A' and 'B' busbars are lit.

(3) Conclusion

(a) Repeat operations (1)(b) and (c).

(b) Disconnect and remove the four test lamps. Close and secure the circuit breaker panels opened in operation (1)(d).

(c) Remove the safety clips and reset the circuit breakers tripped in operation (1)(c).

(d) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

E. 'A' and 'B' Avionics 115 V 400 Hz AC Busbars Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Isolate the 'A' and 'B' systems avionics busbars by tripping the circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
AVIONIC LOAD SHED 'A' SYS SUP	21-215	1X520	-
AVIONIC LOAD SHED 'B' SYS SUP	21-216	2X520	-

(d) Gain access to the 115 V 400 Hz 'A' and 'B' avionics busbars on panels 13-215 and 13-216 respectively, by opening these circuit breaker panels.

(e) Connect 115 V neon test indicators, one between each 115 V avionics busbar and earth. Neon indicator connection points, suitable for each busbar, are as follows:-

'A' avionics busbar:	Terminal 1 of circuit breaker 1C18 on panel 13-215, map ref.A5.
'B' avionics busbar:	Terminal 1 of circuit breaker 2S4 on panel 13-216, map ref.G19.

(f) Remove the safety clips and reset the circuit breakers tripped in operation (c).

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Check that both neon indicators connected in operation (1)(e) are lit.

(b) Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG" and check that both neon test indicators go out; return both switches to "NORM" and ensure that both neon test indicators are lit.

(3) Conclusion

(a) Repeat operations (1)(b) and (c).

(b) Disconnect and remove the two neon test indicators. Close and secure the circuit breaker panels opened in operation (1)(d).

(c) Remove the safety clips and reset the circuit breakers tripped in operation (1)(c).

(d) Remove the warning placard from the ground power rig and disconnect electrical ground

power as detailed in 24-41-00.

F. 115/26 V AC Standby Inverter Supplies and Control Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Isolate the 115 V and 26 V a.c. standby busbars by tripping the 115 V A.C. STBY TRANS SUP circuit breaker X137 on panel 2-213, map ref.B22. Fit a safety clip to the tripped circuit breaker.

(d) Gain access to the 115 V and 26 V a.c. standby busbars on panel 2-213 by opening this circuit breaker panel.

(e) Connect the 110 - 125 V a.c. voltmeter and the 350 - 450 Hz frequency meter between the 115 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker X134 on panel 2-213, map ref.C18, as a suitable point for connection of the voltmeter and frequency meter to the busbar.

(f) Connect a 28 V test lamp between the 26 V a.c. standby busbar and earth. Use terminal 1 of circuit breaker 1F88, map ref.B1, as a suitable point for connection of the test lamp to the busbar.

(g) Remove the safety clip and reset the circuit breaker tripped in operation (1)(c).

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground

power by setting the ground power control switch to "CLOSE" and releasing it. Check that -

a1) the supply voltage and frequency (approx. 115 V 400 Hz) are indicated on the test voltmeter and frequency meter connected to the 115 V a.c. standby busbar, and

a2) the test lamp connected to the 26 V a.c. standby busbar is lit.

(b) Set the ground power control switch to "TRIP" and release it. Check that the indications on the test voltmeter and frequency meter fall to zero and the test lamp goes out.

(c) Isolate the 115 V a.c. standby busbar from the 'normal' supply busbar (No.1 essential) by tripping the 115 V A.C. STBY TRANS SUP circuit breaker X137 on panel 2-213, map ref.B22. Fit a safety clip to the tripped circuit breaker.

(d) Set the ground power control switch to "CLOSE" and release it. Check that the indications on the test voltmeter and frequency meter remain at zero and the test lamp remains out.

WARNING: THE CONTROL SWITCHES ON THE RAM AIR TURBINE (RAT) CONTROL PANEL ARE EACH GUARDED TO PERMIT OPERATION OF A SWITCH TO THE 'TEST' POSITION ONLY, AS REQUIRED FOR THE FOLLOWING TEST.

THESE GUARDS MUST NOT BE RAISED SINCE OPERATION OF EITHER SWITCH TO THE 'ON' POSITION WILL INITIATE THE AUTOMATIC EXTENSION OF THE RAM AIR TURBINE TO ITS OPERATIONAL POSITION BENEATH THE AIRCRAFT.

(e) On the ram air turbine control panel (14-214), set one of the two control switches to "TEST" and hold. Check that -

e1) the TEST caption on the panel is illuminated,

e2) the static inverter (X140) is energized and its output is connected to the 115 V a.c. standby busbar, by observing the indications on the test voltmeter and

frequency meter, and

e3) the voltage and frequency of the static inverter so indicated are correct, i.e., 115(+5 -8.5) V 400(±8) Hz.

(f) Release the RAT switch held at TEST to "OFF". Check that -

f1) the TEST caption is extinguished and

f2) the indications on the test voltmeter and frequency meter fall to zero, indicating that the static inverter power supply is removed from the 115 V a.c. standby busbar.

(g) Repeat operations (e) and (f), using the other one of the two control switches on the ram air turbine control panel.

(h) Remove the safety clip and reset the circuit breaker tripped in operation (c). Check that the supply voltage and frequency (approx. 115 V 400 Hz) are indicated on the testmeters and the test lamp is lit.

(3) Conclusion

(a) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(b) Disconnect and remove the test voltmeter and frequency meter and the test lamp. Close and secure the circuit breaker panel opened in operation (1)(d).

(c) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

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G. DC Essential/Main Split - AC Undervolt Control Functional Test

WARNING: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(b) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(c) Gain access to No.3 main a.c. undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover, then disconnect and secure the cable from terminal 4 (earth) of the undervolt unit. Refit the terminal cover, then close and secure the circuit breaker panel.

(2) Test

(a) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT A and BATT B control switches to "BATT ON". On the main generating control panel, check that No.3 AC MAIN BUS and No.3 AC ESS BUS captions are illuminated and that the 'A' and 'B' essential/main split magnetic indicators display in-line.

(b) Set Nos.1, 2 and 4 bus-tie breaker (BTB) control switches to "TRIP". Check that -

b1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are illuminated,

b2) the load on the d.c. main busbar is supplied by No.3 TRU as indicated on No.3 TRU ammeter, and

b3) both 'A' and 'B' system essential/main split magnetic indicators display cross-line.

NOTE: The loads on the 'A' and 'B' system essential d.c. busbars will be supplied by the batteries.

(c) Set No.1 BTB control switch to "NORM" and

then back to "TRIP", checking that both 'A' and 'B' systems essential/main split magnetic indicators change from cross-line to in-line, and then back to cross-line.

(d) Repeat operation (c) applied in turn to Nos.2 and 4 BTB control switches.

(e) Set BATT A and BATT B control switches to "BATT OFF". Check that the associated magnetic indicators change from in-line to cross-line.

(f) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground supply on.

(g) Gain access to No.3 main undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover and reconnect the cable to terminal 4 (earth) of the undervolt unit, checking the order of the terminal screw washers. Torque-tighten the terminal screw to between 12 and 14 lbf in (0.137 and 0.160 mdaN). Refit the terminal cover. Close and secure the circuit breaker panel.

(h) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT A and BATT B control switches to "BATT ON".

(i) Ensure that Nos.1, 2 and 4 BTB control switches are at TRIP and that No.3 BTB control switch is at NORM, then check that -

i1) Nos.1, 2 and 4 AC MAIN BUS captions and Nos.1, 2 and 4 AC ESS BUS captions are illuminated,

i2) No.3 AC MAIN BUS and No.3 AC ESS BUS captions are extinguished,

i3) the d.c. load is supplied only by No.3 TRU as indicated on No.3 TRU ammeter, and

i4) both 'A' and 'B' essential/main split magnetic indicators display in-line.

(j) Set Nos.1, 2 and 4 BTB control switches to "NORM" and check that -

j1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished,

j2) both 'A' and 'B' essential/main split magnetic indicators remain in-line, and

j3) the d.c. load is supplied by Nos.1, 2, 3 and 4 TRUs as indicated on Nos.1, 2, 3 and 4 TRU ammeters.

(k) Set the DC VOLTS selector switch to "MAIN A" or "MAIN B" and check that approximately 28 V is indicated on the d.c. voltmeter, i.e., nominal d.c. voltage.

(l) Set each TRU control switch, in turn, to "ISOL" and check that each TRU ammeter indication falls to zero as the associated ISOL selection is made. When all four TRUs are isolated, check that the d.c. volts indication falls to zero, the DC MAIN BUS caption is illuminated and both 'A' and 'B' essential/main split magnetic indicators display cross-line.

NOTE: Isolation of the d.c. main busbar is initiated by undervolt detectors that have an inverse time delay and, normally, d.c. main busbar isolation will occur between 2 and 10 s after the last TRU is switched off.

(m) Return all four TRU control switches to "NORM" and check that the d.c. voltmeter registers the nominal d.c. voltage, the DC MAIN BUS caption is extinguished and the essential/ main split magnetic indicators display in-line.

(n) Set BATT A and BATT B control switches to "BATT OFF" and check that the associated magnetic indicators change from in-line to cross-line.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

H. Main Generation Dormant Circuits Functional Test

NOTE: This test includes the checking of BTB and GCB operation by the associated manual and automatic control equipment.

CAUTION: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

(1) Prepare

(a) Connect electrical ground power to the ground services distribution system only (Ref. 24-41-00, Servicing, para.2.A.). If already connected, ensure that ground power is disconnected from the main a.c. distribution system by operation of the ground power control switch to the TRIP position.

(b) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(c) Gain access to Nos.1, 2, 3 and 4 control and protection units (CPUs) by removing the appropriate panels from the flight compartment racking.

NOTE: Nos.1, 2, 3 and 4 CPUs (1X3, 2X3, 3X3 and 4X3) are mounted on shelves 2-215, 1-215, 1-216 and 2-216 respectively.

(d) Ensure that BATT A and BATT B control switches are set to BATT OFF.

(e) Set all four generator control switches to "OFF".

(f) Check that the SSB control switch is at CLOSE, the BTB control switches are at NORM, the GCB magnetic indicators display cross-line, the BTB magnetic indicators display in-line and the fault indicators on the front of all four control and protection units (CPUs) display 'all black' (no faults).

(g) Check that the 28 V supply switch on the dormant circuit test set is set to OFF and

that all other switches on the test set are set to position 1.

(2) Test

(a) Using the appropriate cable loom and connector supplied therewith, connect the test set to the connector on the front of No.1 CPU.

NOTE: The 28 V d.c. external supply connector on the test set is not used for dormant circuit tests.

(b) Carry out the applicable operations detailed in Table 501 as applied to No.1 channel. Disconnect the test set on completion.

NOTE: Switch numbers prefixed 'S' are test set switches. On the set, switch S1 is identified only by the number of engraved positions, i.e., positions 1-20; switches S2 to S7 are identified by corresponding engravings, i.e., SW2 to SW7. The 'VOLTS' readings are those registered on the test set voltmeter.

(c) Repeat operations (a) and (b) as applied to Nos.2, 3 and 4 CPUs and Nos.2, 3 and 4 channels, in turn.

(3) Conclusion

(a) Refit the panels opened in operation (1)(c).

(b) Remove the warning placard placed in operation (1)(b) and switch off and disconnect electrical ground power as detailed in 24-41-00.

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
1. CPU Internal Power Supplies:				
(1) Set 28 V supply switch on test set to "ON" and check that the GENERATOR ROTATING indicator lamp on the front of the CPU is lit	12(±1)	All black	Cross-line	In-line
(2) Set S1 to "2"	12(±1)	All black	Cross-line	In-line
(3) Set S1 to "3"	-			
Channels				
1 and 4	0	All black	Cross-line	In-line
2 and 3	12(±1)	All black	Cross-line	In-line
(4) Ensure that SSB control switch is set to "CLOSE"	-	-	-	-
(5) Set SSB control switch to "OPEN" (channels 2 and 3 only)	0	-	-	-
(6) Set SSB control switch to "CLOSE" (channels 2 and 3 only)	12(±1)	-	-	-
(7) Set S1 to "4"	12(±1)	All black	Cross-line	In-line
(8) Set S1 to "5"				
Channels				
1 and 4	0	All black	Cross-line	In-line
2 and 3	12(±1)	All black	Cross-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(9) Set SSB control switch to "OPEN" (channels 2 and 3 only)	0	-	-	-
(10) Set SSB control switch to "CLOSE" (channels 2 and 3 only)	12(±1)	-	-	-
(11) Set S1 to "6"	12(±1)	All black	Cross-line	In-line
NOTE: Operation (11) checks test set function only.				
2. Overspeed Circuit:				
(1) Set S1 to "7" and the GCB control switch to "ON"	6(±1)	All black	In-line	In-line
(2) Set S1 to "8" and S7 to "3"	6(±1)	OVERSPEED: white	Cross-line	In-line
(3) Set S7 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	6(±1)	All black	In-line	In-line
3. Average Voltage Sensing Circuit:				
(1) Set S1 to "9" and S2 to "2"	11(±2)	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
4. High Phase Sensing Circuit:				
(1) Set S2 to "1"	6(±1)	All black	In-line	In-line
(2) Set S1 to "10" and S2 to "2"	11(±2)	All black	In-line	In-line
5. Current Limit:				
(1) Set S2 to "1"	6(±1)	All black	In-line	In-line
(2) Set S1 to "11" and S2 to "2"	11(±2)	All black	In-line	In-line
6. Underspeed Circuit:				
(1) Set S2 to "1", S1 to "12" and S7 to "2"	0	All black	Cross-line	In-line
(2) Set S3 to "2" and S7 to "1"	0	UNDER-VOLTAGE: white	Cross-line	Cross-line then In-line
(3) Set S3 to "1", select "OFF" and then "ON" (reset) at the GCB control switch and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
7. Real Load Deficit Circuit:				
(1) Set S1 to "13" and S2 to "2"	0	REAL LOAD DEFICIT: white	In-line	Cross-line after 7(±3) s

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(2) Set S2 to "1" and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
8. Over-excitation (Over-voltage) Circuit:				
(1) Set S1 to "14" and S2 to "2"	0	OVER-VOLTAGE: white	Cross-line	Cross-line
(2) Set S2 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
9. Under-excitation (Under-voltage) Circuit:				
(1) Set S1 to "15" and S3 to "2"	0	UNDER-VOLTAGE: white	Cross-line	Cross-line then In-line
(2) Set S3 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the	0	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
INDICATOR RESET switch on the front of the CPU				
10. Current Unbalance Sensing Circuit:				
(1) Set S1 to "16" and check that the indicator lamp on test set is not lit	-	-	-	-
(2) Set S2 to "2" and then S4 to "2"	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
NOTE: There is a delay between the operation and the fault display.				
(3) Set S2 and S4 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, select "RESET" and then "NORM" at the BTB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(4) Set S1 to "17" and check that the indicator lamp on test set is not lit	-	-	-	-
(5) Repeat operation (2)	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
(6) Repeat operation (3)	0	All black	In-line	In-line
(7) Set S1 to "18" and check that the indicator lamp on test set is not lit	-	-	-	-
(8) Repeat operation (2)	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
(9) Repeat operation (3)	0	All black	In-line	In-line
11. Overcurrent Sensing Circuit:				
(1) Set S1 to "19", set S2 and S5 to "2", and then set S4 to "2" NOTE: There is a delay between the operation and the fault display.	0	BUSBAR: white	Cross-line after BTB	Cross-line after 6(±2) s

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(2) Set S2, S4 and S5 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, select "RESET" and then "NORM" at the BTB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
12. Generator Feeder Fault Circuit:				
(1) Set S1 to "20" and check that the indicator lamp on test set is not lit	-	-	-	-
(2) Set S2 to "2"	0	GENERATOR FEEDER: white	Cross-line	In-line
(3) Set S2 to "1", S1 to "1" and actuate the INDICATOR RESET switch on the front of the CPU, then set 28 V supply switch on test set to "OFF"	0	All black	Cross-line	In-line

Dormant Circuit Test
Table 501

I. Emergency Generation Functional Test - Using Hydraulic Ground Power

CAUTION: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THIS TEST.

(1) Prepare

(a) Check that all a.c. supplies are inhibited and that d.c. power is switched off.

(b) Open circuit breaker panel 1-213 to permit observation of the 'power on' neon indicator lamps that are mounted together on a panel at the end of shelf 12-215 and identified in Table 502.

NEON LAMP	'POWER ON' INDICATION
1X233	No.1 engine relight busbar
2X233	No.2 engine relight busbar
3X233	No.3 engine relight busbar
4X233	No.4 engine relight busbar
X232	Emergency generator

Neon Indicator Lamps on Panel at End of Shelf 12-215
Table 502

(c) Open circuit breaker panels 2-213 and 4-213 to permit observation of the neon indicator lamps that are mounted on the inner face of each panel and identified in Table 503.

NEON LAMP	PANEL	'POWER ON' INDICATION
1X136	2-213	No.1 a.c. essential busbar
2X136	2-213	No.2 a.c. essential busbar
3X136	4-213	No.3 a.c. essential busbar

NEON LAMP	PANEL	'POWER ON' INDICATION
4X136	4-213	No.4 a.c. essential busbar

Neon Indicator Lamps on Panels 2-213 and 4-213
Table 503

(d) Remove the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00) to permit access to the emergency generator control and protection unit (X201) on shelf 5-243.

(e) Make available electrical ground power as detailed in 24-41-00.

(f) Connect and supply ground hydraulic power to the green hydraulic system (Ref. Chap.29).

(2) Test

(a) Set BATT A and BATT B control switches to "BATT ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line. Check also that the d.c. essential/main split magnetic indicators display in-line.

(b) Ensure that the EMERG RELIGHT BUSBAR selector switch on the engine starting panel (18-214) is set to OFF.

(c) Refer to Table 502 and check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are lit.

(d) Refer to Table 503 and check that Nos.1, 2, 3 and 4 a.c. essential busbar 'power on' neon indicator lamps are lit.

(e) Set the AC FREQ/VOLTS selector switch on the electrical generating control panel to "EMERG PWR".

(f) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "EMERG"; Nos.1 and 2,

3 and 4 AC ESS BUS captions must be illuminated.

(g) Set the emergency generator mode switch to "MANUAL" and check that the emergency generator commences running, by observing the voltage and frequency indications on the associated meters (approx. 115 V 400 Hz). Check also that -

g1) the emergency generator 'power on' neon indicator lamp is lit (Ref. Table 502),

g2) the emergency generator FAIL caption is not illuminated,

g3) Nos.1 and 2 AC ESS BUS captions are extinguished, but Nos.3 and 4 AC ESS BUS captions remain illuminated,

g4) an emergency generator load is indicated on the emergency generator kVA meter, and

g5) the emergency generator voltage and frequency indications are not fluctuating.

(h) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "NORM"; Nos.1, 2, 2 and 4 AC ESS BUS captions must be extinguished.

NOTE: The following operations (i) to (n), inclusive, involve the use of switches, fitted at the front panel of the emergency generator control and protection unit, to test the generator trip function of the internal overvoltage protection and differential current protection circuits and to reset the fault indicators on the unit after operation. One of these switches (SW4), is of the push-button type, the remainder (SW1, SW2, SW3 and SW5) are microswitches which are operated by insertion of a suitable probe through the corresponding access hole.

(i) Locate switches SW4 and SW2 on the emergency generator control and protection unit and observe the emergency generator indicators on the electrical generating control panel. Press switches SW4 and SW2, both together, hold both depressed for a period of not less than 1.5 s, then release both switches. Check that -

i1) the emergency generator is de-excited, by observing that the voltage and frequency indicators fall to zero,

i2) the emergency generator FAIL caption is illuminated, and

i3) the overvoltage fault indicator on the emergency generator control and protection unit displays OV.

(j) Press-to-test the emergency generator FAIL caption to initiate the generator reset facility of the emergency generator control and protection unit. Check that -

j1) the emergency generator FAIL caption is extinguished, and

j2) the output of the emergency generator is reinstated, by observing that the voltage and frequency indications are correct (approx. 115 V 400 Hz).

(k) Press and then release the overvoltage fault indicator reset switch SW1 on the emergency generator control and protection unit and check that the OV display disappears.

(l) Locate switches SW4 and SW3 on the emergency generator control and protection unit and observe the emergency generator indicators on the electrical generating control panel. Press switches SW4 and SW3 both together, then release both switches without delay. Check that -

l1) the emergency generator is de-excited, by observing that the voltage and frequency indications fall to zero,

l2) the emergency generator FAIL caption is illuminated, and

l3) the differential protection fault indicator on the emergency generator control and protection unit displays DP.

(m) Press-to-test the emergency generator FAIL caption to initiate the generator reset facility of the emergency generator control and protection unit. Check that -

m1) the emergency generator FAIL caption is extinguished, and

m2) the output of the emergency generator is reinstated, by observing that the voltage and frequency indications are correct (approx. 115 V 400 Hz).

(n) Press and then release the differential protection fault indicator reset switch SW5 on the emergency generator control and protection unit and check that the DP display disappears.

(o) Isolate Nos.1, 2, 3 and 4 engine relight busbars from main a.c. busbars supplies by tripping the circuit breakers listed below and fitting safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
NO.1 RELT NORM SUP	22-215	1X226	-
NO.2 RELT NORM SUP	21-215	2X226	-
NO.3 RELT NORM SUP	21-216	3X226	-
NO.4 RELT NORM SUP	22-216	4X226	-

(p) Refer to Table 502 and check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are extinguished.

(q) Refer to Table 502. Select positions "2", "4", "3" and "1" in turn on the EMERG RELIGHT BUSBAR selector switch and check that as each busbar is selected, the correspondingly-numbered engine relight busbar 'power on' neon indicator lamp is lit.

(r) Set the EMERG RELIGHT BUSBAR selector switch to "OFF" and check that all four engine

relight busbar 'power on' neon indicator lamps (Ref. Table 502) are extinguished.

(s) Set the emergency generator isolate switch to "ISOL" and then set the emergency generator mode switch to "AUTO". Check that the emergency generator ceases running, by observing that the voltage and frequency indications fall to zero, then reset the isolate switch to "NORM".

(3) Conclusion

(a) Remove the safety clips and reset the circuit breakers tripped in operation (2)(o). Check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are lit.

(b) Switch off and disconnect the ground hydraulic supply (Ref. Chap.29).

(c) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground supply on.

(d) Close and secure circuit breaker panels 1-213, 3-213 and 4-213.

(e) Refit the rear vestibule LH electronic racking forward and decor bulkheads (Ref. 25-71-00).

(f) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

R **ON A/C 001-006,

J. AC and DC Generation Master Warning Functional Test

CAUTION: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

NOTE: Checks of the master warning test facilities associated with main generator operation are contained in the functional test using main engines (Ref. para.K.).

(1) Prepare

(a) Open the engine bay doors as required to gain access to Nos.1, 2, 3 and 4 integrated drive generators (IDGs) (Ref. 71-00-00).

(b) Make all four CSD failure warning circuits inoperative by disconnecting the electrical connector from the oil low pressure warning switch at each IDG, i.e., connector 1X1-C (No.1 IDG), 2X1-C (No.2 IDG), 3X1-C (No.3 IDG) and 4X1-C (No.4 IDG).

(c) Isolate all four generator (GEN) failure warning indication circuits by tripping the following circuit breakers. Fit safety clips to the tripped circuit breakers.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
No.1 & 2 GEN FAIL WARN IND.	1-213	1X12	P9
No.3 & 4 GEN FAIL WARN IND.	3-213	4X12	E10

(d) Make available electrical ground power as detailed in 24-41-00.

NOTE: The settings/indications of controls and indicators checked at the following operation (e) are those usual upon satisfactory connection of a ground power supply to the main a.c. distribution system (ground power breaker (GPB) closed).

(e) Check that the electrical power distribution system is set for normal operation by ensuring that -

e1) the AC FREQ/VOLTS selector switch is set to GRND PWR and that the correct voltage and frequency are indicated on the a.c. voltmeter and frequency meter,

e2) the battery control switches are at BATT OFF, the associated 'battery isolate' magnetic indicators display cross-line, and the essential/main split magnetic indicators display in-line,

e3) the SSB control switch is at CLOSE and the SSB position magnetic indicator displays in-line,

e4) Nos.1, 2, 3 and 4 BTB control switches are at NORM and all four BTB position magnetic indicators display in-line,

e5) all four generator circuit breaker (GCB) position magnetic indicators and the auto shed breaker (ASB) position magnetic indicator display cross-line,

e6) all four essential/main (NORM/EMERG) control switches are at NORM and the associated essential/main isolate magnetic indicators display in-line, and

e7) all four TRU control switches are at NORM.

(2) Test

(a) On the electrical generating control panel, check that the GRND PWR AVAILABLE caption and both BATT ISOLATE captions are illuminated and that all other captions are extinguished.

(b) Set both battery control switches to "BATT ON". Check that both 'battery isolate' magnetic indicators display in-line and that both BATT ISOLATE captions are extinguished.

(c) Press the RECALL button on the master warning display panel; some master warning captions may be illuminated. Press the face of all captions on the master warning display panel that are illuminated and check that each is extinguished (warning cancelled).

(d) Press the face of the No.1 AC MAIN BUS caption and check that -

d1) the caption is illuminated,

d2) the amber ELEC caption on the master warning display panel is illuminated, and

d3) the audio warning (single-stroke gong) sounds.

(e) Release the face of the caption pressed in operation (d) and check that -

e1) the caption is extinguished, and

e2) the amber ELEC caption on the master warning display panel is extinguished.

(f) Repeat operations (d) and (e), in turn, as applied to each of the following captions:-

No.2 AC MAIN BUS

No.3 AC MAIN BUS

No.4 AC MAIN BUS

DC MAIN BUS

'A' BATT ISOLATE

'B' BATT ISOLATE

(g) Set No.1 BTB control switch to "TRIP". Check that -

g1) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are illuminated,

g2) the amber ELEC and the red ELEC captions on the master warning display panel are illuminated, and

g3) the audio warning (single-stroke gong) sounds.

(h) Return No.1 BTB control switch to "NORM". Check that -

h1) the correspondingly-numbered AC MAIN BUS and AC ESS BUS captions are extinguished, and

h2) the amber ELEC and the red ELEC captions

on the master warning display panel are extinguished.

(i) Repeat operations (g) and (h), in turn, as applied to Nos.2, 3 and 4 BTB control switches.

(j) Trip the 'A' SYS MAIN U/VOLT UNIT SUP circuit breaker 1P13 on panel 15-215, map ref.A2. Check that -

j1) the DC MAIN BUS caption is illuminated, the amber ELEC caption on the master warning display panel is illuminated, and

j2) the audio warning (single-stroke gong) sounds.

(k) Reset the 'A' SYS MAIN U/VOLT UNIT SUP circuit breaker 1P13 on panel 15-215, map ref.A2. Check that -

k1) the DC MAIN BUS caption is extinguished, and

k2) the amber ELEC caption on the master warning display panel is extinguished.

(l) Set 'A' battery control switch to "BATT OFF". Check that the associated BATT ISOLATE caption is illuminated, the amber ELEC caption on the master warning display panel is illuminated and the audio warning (single-stroke gong) sounds. Return the switch to "BATT ON" and check that the associated BATT ISOLATE caption and the amber ELEC caption are extinguished.

(m) Repeat operation (l) as applied to the 'B' battery control switch.

(n) Press the RECALL button on the master warning display panel and ensure that the red ELEC and amber ELEC captions remain extinguished; some other master warning captions may be illuminated. Press the face of all other captions on the master warning panel that are illuminated and check that each is extinguished (warning cancelled).

(o) Press the face of No.1 AC ESS BUS caption and check that -

o1) the caption is illuminated,

o2) the red ELEC caption on the master warning display panel is illuminated, and

o3) the audio warning (single-stroke gong) sounds.

(p) Release the face of the caption pressed in operation (o) and check that -

p1) the caption is extinguished, and

p2) the red ELEC caption on the master warning display panel is extinguished.

(q) Repeat operations (o) and (p), in turn, as applied to each of the following captions:-

No.2 AC ESS BUS

No.3 AC ESS BUS

No.4 AC ESS BUS

'A' system DC ESS BUS

'B' system DC ESS BUS

(r) Trip the 'A' ESS U/VOLT UNIT SUP circuit breaker 1P26 on panel 1-213, map ref.M8. Check that -

r1) the 'A' system DC ESS BUS caption is illuminated,

r2) the red ELEC caption on the master warning display panel is illuminated, and

r3) the audio warning (single-stroke gong) sounds.

(s) Reset the 'A' ESS U/VOLT UNIT SUP circuit breaker 1P26 on panel 1-213, map ref.M8. Check that -

s1) the 'A' system DC ESS BUS caption is extinguished, and

s2) the red ELEC caption on the master warning display panel is extinguished.

(t) Trip the 'B' ESS U/VOLT UNIT SUP circuit breaker 2P26 on panel 3-213, map ref.E12. Check that -

t1) the 'B' system DC ESS BUS caption is illuminated,

t2) the red ELEC caption on the master warning display panel is illuminated, and

t3) the audio warning (single-stroke gong) sounds.

(u) Reset the 'B' ESS U/VOLT UNIT SUP circuit breaker 2P26 on panel 3-213, map ref.E12. Check that -

u1) the 'B' system DC ESS BUS caption is extinguished, and

u2) the red ELEC caption on the master warning display panel is extinguished.

(v) Press the face of the emergency generator O/HEAT caption and check that -

v1) the caption is illuminated,

v2) the red ELEC caption on the master warning display panel is illuminated, and

v3) the audio warning (single-stroke gong) sounds.

(w) Release the face of the emergency generator O/HEAT caption and check that -

w1) the caption is extinguished, and

w2) the red ELEC caption on the master warning display panel is extinguished.

(x) Press the face of the caption CSD 1 and check that -

x1) the caption is illuminated,

x2) the amber ELEC caption on the master warning display panel is illuminated, and

x3) the audio warning (single-stroke gong) sounds.

(y) Release the face of the caption pressed in operation (x) and check that -

y1) the caption is extinguished, and

y2) the amber ELEC caption on the master warning display panel is extinguished.

(z) Repeat operations (x) and (y), in turn, as applied to each of the following captions:-

CSD 2

CSD 3

CSD 4

(aa) Set both battery control switches to "BATT OFF".

(ab) Remove the safety clips and reset the circuit breakers tripped in operation (1)(c). Ensure that the captions GEN 1, GEN 2, GEN 3 and GEN 4 are illuminated.

(3) Conclusion

(a) Set the ground power control switch on the electrical generating control panel to "TRIP" and release it.

(b) At each IDG, reconnect the connector disconnected in operation (1)(b), ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock each connector (Ref. Wiring Diagram Manual, 20-42-48).

(c) Set the ground power control switch on the electrical generating control panel to "CLOSE" and release it. Ensure that the captions CSD 1, CSD 2, CSD 3 and CSD 4 are illuminated.

(d) Close the engine bay doors (Ref. 71-00-00).

(e) Switch off and disconnect electrical ground power as detailed in 24-41-00.

K. AC Generation Functional Test - Using Main Engines

NOTE: On the electrical generating control panel, the abbreviation CSD (constant speed drive) is used on associated control and indication equipment to identify the transmission component of the IDG (integrated drive generator) in each main generation channel.

(1) Prepare

(a) Ensure that the aircraft power unit installation and systems are cleared and safe for the ground running of all four engines to be carried out (Ref. Chap.71).

(b) Ensure that the integrated drive generator (IDG) fitted to each engine has been cleared for running (Ref. 24-11-11, Inspection/Check) and that the transmission (constant speed drive) is engaged.

(c) Make available electrical ground power as detailed in 24-41-00.

NOTE: The settings/indications of controls and indicators checked at the following operation (d) are those usual upon satisfactory connection of a ground power supply to the main a.c. distribution system (ground power breaker (GPB) closed).

(d) Check that the electrical power distribution system is set for normal operation by ensuring that -

d1) the AC FREQ/VOLTS selector switch is set to GRND PWR and that the correct voltage and frequency are indicated on the a.c. voltmeter and frequency meter,

d2) the battery control switches are at BATT OFF, the associated 'battery isolate' magnetic indicators display cross-line, and the essential/main split magnetic indicators display in-line,

d3) the SSB control switch is at CLOSE and the SSB position magnetic indicator displays in-line,

d4) Nos.1, 2, 3 and 4 BTB control switches

are at NORM and all four BTB position magnetic indicators display in-line,

d5) all four generator circuit breaker (GCB) position magnetic indicators and the auto shed breaker (ASB) position magnetic indicator display cross-line,

d6) all four essential/main (NORM/EMERG) control switches are at NORM and the associated essential/main isolate magnetic indicators display in-line, and

d7) all four TRU control switches are at NORM.

(e) Ensure that all four generator control switches are set to ON.

(f) In readiness for engine starting, set BATT A and BATT B control switches to "ON", checking that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(g) Before engine starting, check that -

g1) the generator failure captions GEN 1, GEN 2, GEN 3 and GEN 4 are illuminated and all four generator circuit breaker (GCB) position magnetic indicators display cross-line, and

g2) the constant speed drive (CSD) failure captions CSD 1, CSD 2, CSD 3 and CSD 4 are illuminated.

(2) Test

CAUTION: IF A CSD (CONSTANT SPEED DRIVE) FAILURE CAPTION REMAINS ILLUMINATED AFTER THE ASSOCIATED ENGINE HAS RUN UP TO A SPEED OF 62 PER CENT N2 OR ABOVE, ABNORMAL OPERATION OF THE IDG IS INDICATED. THE CSD DISCONNECT SWITCH MUST THEN BE OPERATED TO THE "DISC" POSITION TO EFFECT DISENGAGEMENT OF THE IDG TRANSMISSION.

DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT

SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

(a) Start and run No.1 engine at a speed above 62 per cent N2, noting the procedures to be carried out if excessive CSD OIL INLET temperature is indicated during the engine run (Ref. 71-00-00). Check that -

a1) the associated CSD failure caption is extinguished,

a2) the associated GEN failure caption is extinguished, and

a3) the associated GCB position magnetic indicator displays in-line.

(b) With No.1 engine running at a speed above 62 per cent N2, check that the auto shed breaker (ASB) position magnetic indicator displays in-line.

(c) Repeat operation (a), in turn, for Nos.2, 3 and 4 engines. If the automatic paralleling of a generator is not effected, i.e., the associated CSD failure caption is extinguished but the associated GEN failure caption remains illuminated and the associated GCB position magnetic indicator remains cross-line, assist paralleling as follows:-

c1) Identify the generator with the lowest frequency identification by using the AC FREQ/VOLTS selector switch, then

c2) momentarily press the P/ASSIST push-switch associated with the generator giving the lowest frequency indication.

NOTE: Operation of a P/ASSIST push-switch affects the CSD (IDG transmission) output speed and momentarily increases the generator frequency by approximately 3 Hz. This permits automatic paralleling where previously the generators were either running synchronized but at incorrect phase angle, or their frequency difference was greater than 4 Hz.

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(d) Where the operation of a P/ASSIST switch has been necessary to bring a generator into parallel operation, record the frequency of each generator as indicated on the frequency meter, by holding Nos.1, 2, 3 and 4 generator control switches, in turn, at "TEST" with the AC FREQ/VOLTS selector switch set to the corresponding generator position. If a difference in frequency greater than 4 Hz is registered between any two generators, the associated CSD(s) must be adjusted.

NOTE: If CSD (IDG transmission) adjustment is necessary, refer to 24-11-00, Main Generator Drive, Adjustment/Test.

(e) Set the AC FREQ/VOLTS selector switch to "GEN 1", "GEN 2", "GEN 3" and "GEN 4", in turn, and check that the nominal voltage and frequency (approx. 115 V 400 Hz) are displayed on the voltmeter and frequency meter at each switch position.

(f) Check that the paralleling of Nos.1, 2, 3 and 4 main generation channels is established, by observing that -

f1) Nos.1, 2, 3 and 4 bus-tie breaker (BTB) position magnetic indicators display in-line, and

f2) Nos.1, 2, 3 and 4 AC MAIN BUS and Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished.

(g) Note the reading in kilowatts indicated on Nos.1, 2, 3 and 4 KW/KVAR meters. Check that any difference in load sharing does not exceed 6 kW.

(h) Press the PUSH FOR KVAR push-switch and note the reading on Nos.1, 2, 3 and 4 KW/KVAR meters. Check that any difference in load sharing, so indicated, does not exceed 4 kVAR.

(i) Check that the IDG oil temperature is indicated on the INLET and DIFF scales of the correspondingly-numbered CSD oil temperature indicators and that the overheat warning lamp on the front of each indicator is not lit.

NOTE: Under ground running conditions, the oil inlet temperature and differential temperature will be approximately 80 deg C and 15 deg C respectively. These values will vary according to the generator load and the ambient temperature.

(j) Press the face of the caption GEN 1 and check that -

j1) the caption is illuminated,

j2) the amber ELEC caption on the master warning display panel is illuminated, and

j3) the audio warning (single-stroke gong) sounds.

(k) Release the face of the caption pressed in operation (j) and check that -

k1) the caption is extinguished, and

k2) the amber ELEC caption on the master warning display panel is extinguished.

(l) Repeat operations (j) and (k), in turn, as applied to each of the following captions:-

GEN 2

GEN 3

GEN 4

Before SB 24-023

NOTE: The following operations (m) to (r), inclusive, are optional. They provide a convenient method of checking operation of the emergency generator automatic start and auto-shed breaker (ASB) control circuits and the 26 V a.c. 'A' and 'B' main busbar load shedding control circuits.

(m) Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator remains inoperative, i.e., the SELECTED caption is not illuminated.

(n) Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG". Check that the emergency generator starts running, i.e., the SELECTED caption is illuminated and the FAIL caption is not illuminated. Check also that -

n1) Nos. 2 and 3 AC ESS BUS captions are extinguished, indicating that the output of the emergency generator is connected to the associated busbars via the 'A' and 'B' system emergency busbars,

n2) the emergency generator voltage and frequency are correct (approx. 115 V 400 Hz) and not fluctuating, and

n3) the 'A' and 'B' system 26 V a.c. main busbars are shed, by observing that the power supply failure warning flag is visible on the blue system quantity indicator and the yellow system quantity indicator on the hydraulic management panel.

(o) Return Nos.2 and 3 essential/main (NORM/EMERG) control switches to "NORM". Check that the emergency generator SELECTED caption is extinguished and the emergency generator ceases running. Check also that power is restored to the 'A' and 'B' system 26 V main a.c. busbars, by observing that the power supply failure warning flag has disappeared from the blue hydraulic system quantity indicator and the yellow hydraulic system quantity indicator.

(p) Shut down No.1 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2, the emergency generator does not commence running, i.e., the SELECTED caption is not illuminated.

(q) Shut down No.2 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2 -

q1) the ASB position magnetic indicator changes from in-line to cross-line, and

q2) the emergency generator SELECTED caption is illuminated, followed by illumination of the FAIL caption after a short period.

NOTE: The pressurizing supply for the green hydraulic system is provided by No.1 and/or No.2 engine-driven pump(s). Thus, with shut-down of both Nos.1 and 2 engines, power to sustain operation of the emergency generator will be lost. Residual pressure in the system will, however, enable the emergency generator to start and run at normal operating speed for a short period, after which the decay of system pressure will result in generator run-down and illumination of the FAIL warning caption.

(r) Set the emergency generator mode switch to "AUTO", then set the emergency generator isolate switch to "ISOL". Return the emergency generator isolate switch to "NORM" and check that the SELECTED and FAIL captions are extinguished.

After SB 24-023 For A/C 001-004,

012-012, 016-016

NOTE: The following operations (m) to (s), inclusive, are optional. They provide a convenient method of checking operation of the emergency generator automatic start and auto-shed breaker (ASB) control circuits and the 26 V a.c. 'A' and 'B' main busbar load shedding control circuits.

(m) Check that the emergency generator mode switch is at AUTO and that the emergency generator SELECTED caption is not illuminated.

(n) Set Nos.2 and 3 essential/main (NORM/EMERG) control switches to "EMERG". Check that the emergency generator starts running, i.e., the SELECTED caption is illuminated and the FAIL caption is not illuminated. Check also that -

n1) Nos.2 and 3 AC ESS BUS captions are extinguished, indicating that the output of the emergency generator is connected to the associated busbars via the 'A' and 'B' system emergency busbars,

n2) the emergency generator voltage and frequency are correct (approx. 115 V 400 Hz) and not fluctuating, and

n3) the 'A' and 'B' system 26 V a.c. main busbars are shed, by observing that the power supply failure warning flag is visible on the blue system quantity indicator and the yellow system quantity indicator on the hydraulic management panel.

(o) Return Nos.2 and 3 essential/main (NORM/EMERG) control switches to "NORM". Check that the emergency generator SELECTED caption remains illuminated and the emergency generator continues running. Check also that power is restored to the 'A' and 'B' system 26 V a.c. main busbars, by observing that the power supply failure warning flag has disappeared from the blue hydraulic system quantity indicator and the yellow hydraulic system quantity indicator.

(p) Set the emergency generator mode switch to GRD BY-PASS and check that the emergency generator SELECTED caption is extinguished and the emergency generator ceases running.

(q) Shut down No.1 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2, the emergency generator does not commence running, i.e., the SELECTED caption is not illuminated.

(r) Shut down No.2 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2 -

r1) the ASB position magnetic indicator changes from in-line to cross-line, and

r2) the emergency generator SELECTED caption is illuminated, followed by illumination of the FAIL caption after a short period.

NOTE: The pressurizing supply for the green hydraulic system is provided by No.1 and/or No.2 engine-driven pump(s). Thus, with shut-down of both Nos.1 and 2 engines, power to sustain operation of the emergency generator will be lost. Residual pressure in the system will, however, enable the emergency generator to start and run at normal operating speed for a short period, after which the decay of system pressure will result in generator run-down and illumination of the FAIL warning caption.

(s) Set the emergency generator mode switch to "AUTO", then set the emergency generator isolate switch to "ISOL". Return the emergency generator isolate switch to "NORM" and check that the SELECTED and FAIL captions are extinguished.

(3) Conclusion

(a) If not already effected, shut down Nos.1 and 2 engines (Ref. Chap.71).

(b) Shut down Nos.3 and 4 engines (Ref. Chap.71).

(c) Set BATT A and BATT B control switches to "BATT OFF".

(d) Switch off and disconnect electrical ground power as detailed in 24-41-00.

R **ON A/C 001-006,

4. Electrical Bonding

(1) The requirements for electrical bonding are given in 20-27-11.

(2) The verification of electrical bonding is necessary when -

(a) existing bonding connections have been disturbed by maintenance procedures, or

(b) there is reason to suspect contamination, corrosion

or damage, or

(c) a malfunction (e.g., radio interference) is being investigated.

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END OF THIS SECTION

NEXT

MAIN GENERATOR DRIVE - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

The four main a.c. generators (Nos.1, 2, 3 and 4) are each coupled to a correspondingly numbered main engine. Each generator is driven by the associated engine accessory gearbox through an axial gear differential transmission which drives the generator at a constant speed throughout the normal operating speed of the engine. The transmission and the associated generator are assembled as a unit forming an integrated drive generator (IDG) (Ref. 24-11-11).

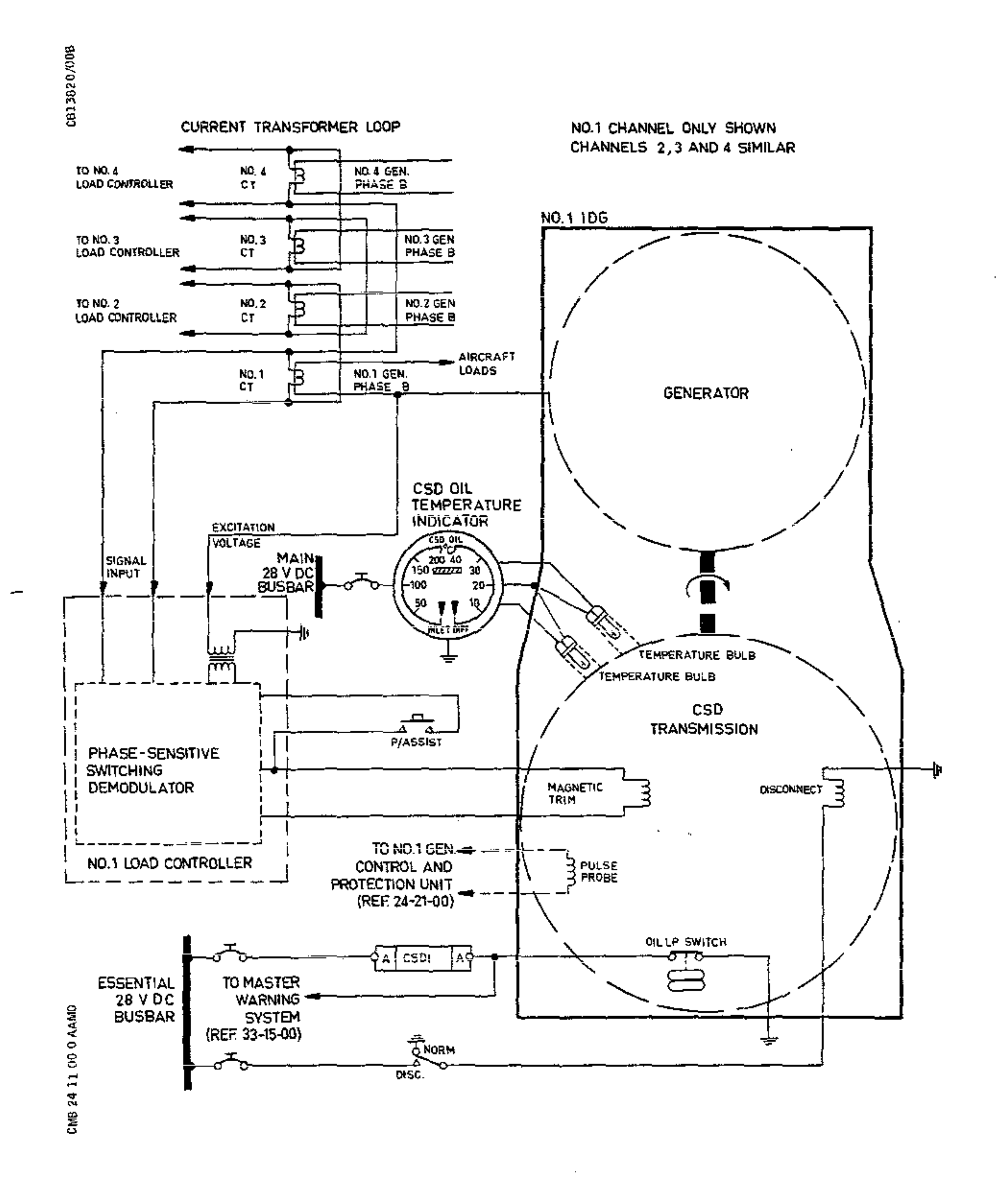
The term 'constant speed drive' (CSD) is subsequently used to identify the transmission component of an IDG and the abbreviation CSD is used for the identification of associated control and indication equipment. As the frequency of an a.c. generator is a function of the speed of rotation, the CSD ensures that the generator output frequency is maintained within very close limits.

The CSD component of each IDG consists of a variable hydraulic transmission controlled by a mechanical governor. The transmission adds or subtracts speed to the input from the accessory gearbox in order to provide the required constant output speed. The CSD oil system is used also to cool and lubricate the associated generator; the oil system is contained within the IDG but makes use of the engine oil cooler.

When two or more generators operate in parallel, load controllers, in conjunction with current transformers in the main a.c. generation system, provide electrical signals to 'trim' the CSD governors for precise speed control and ensure equal load sharing between generators.

CSD 'Control and Indication' is separate for each main generator channel. A CSD disconnect switch controls a disconnect mechanism in the CSD component of the associated IDG. A parallel-assist push-switch, when operated, increases the output signal of the associated load controller which in turn increases the CSD output speed.

In each IDG, a pressure switch controls an associated CSD caption light which indicates low charge oil pressure. Signals operating the caption light are also passed to the master warning system (Ref. 33-15-00). Charge oil is the oil under pressure of a charge pump which supplies oil to the CSD and to the generator for cooling and lubrication. In addition, two temperature probes (bulbs) sense inlet and outlet temperature for an associated CSD temperature indicator which presents oil temperature information by



R - Main Generator Drive - Simplified Schematic
Figure 001

means of two pointers read against dial scales. The main generator drive controls, captions and indicators are located at the third crew member's station.

2. Constant Speed Drive (CSD) (Ref. Fig.001 and 002)

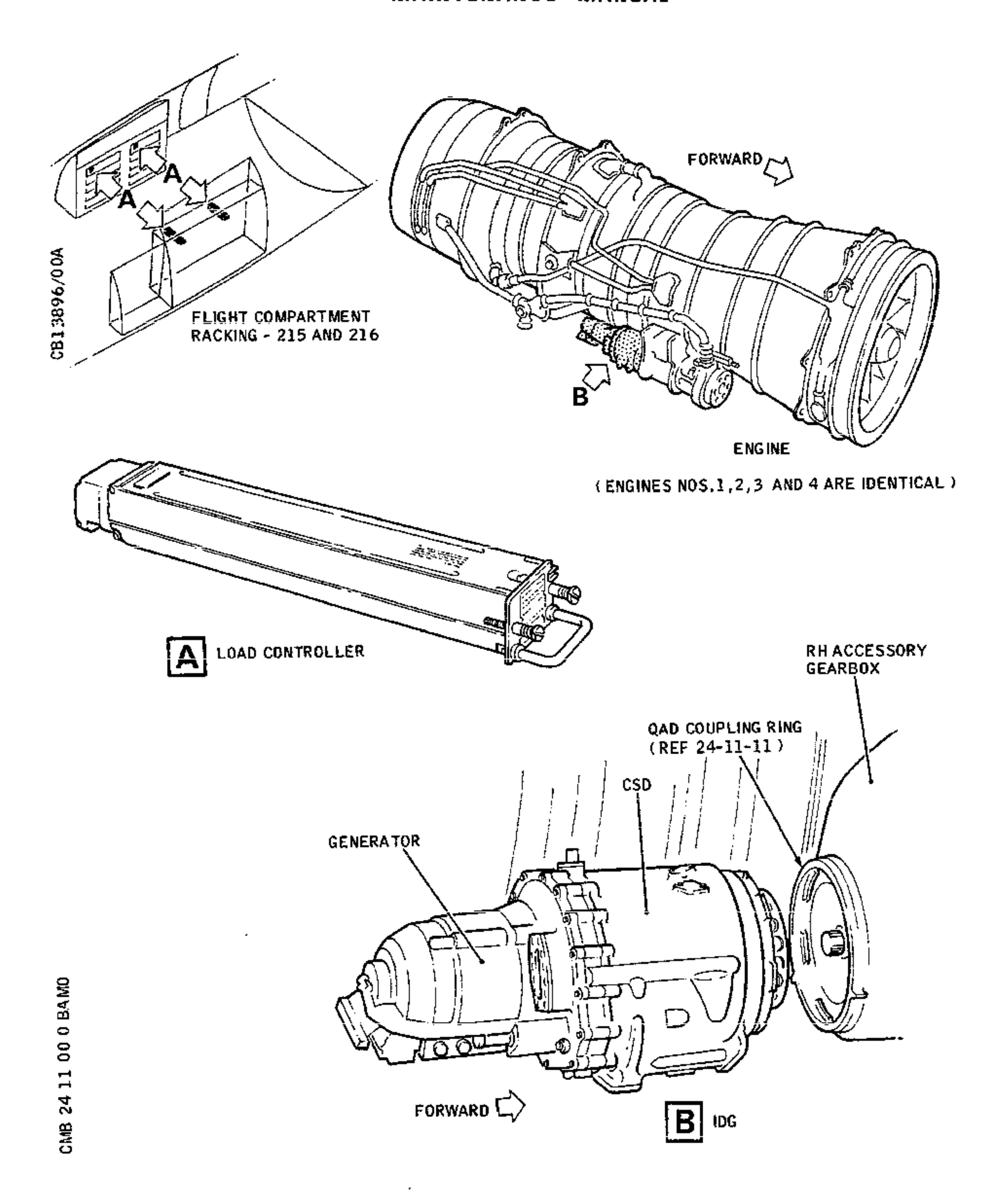
The CSD (transmission) component of an IDG is fully described under Integrated Drive Generator (Ref. 24-11-11).

The CSD input shaft drives the input gear through a solenoid-operated disconnect mechanism. This enables the drive to be disconnected from the engine by the associated CSD disconnect switch in the event of a CSD/generator-fault. The drive can be re-engaged only by use of a disconnect reset handle on the IDG with the engine stopped. The IDG disconnect reset handle is located at the bottom of the IDG and labelled RESET WITH ENGINE STATIC. This reset handle is connected to a disconnect plunger which is spring-loaded and normally held retracted by the nose pin of the disconnect solenoid. When the disconnect solenoid is energized, the disconnect plunger is released and engages the disconnect mechanism so that the IDG is disconnected from the input (drive) shaft. The reset handle enables the disconnect plunger to be withdrawn to the position at which it is engaged by the solenoid nose pin.

The main transmission consists of a geared differential controlled through a variable hydraulic pump and motor unit. Action of the hydraulic unit is varied by a flyweight governor which incorporates a magnetic trimming device. This device is used for generator load sharing and parallel-assist control. For generator control and protection purposes, an electrical signal representing the output speed is derived from a pulse probe acting on an output driven gear.

The output shaft assembly includes a sprag clutch as a protection against generator motoring conditions. The output shaft drives the pumps of the integral oil system. This system is contained within the IDG casing, incorporating a reservoir, by-pass valves, and charge oil and scavenge filters. Cooling is effected by the routing of external piping through a section of the engine oil cooler. A pressure switch senses charge oil pressure and is used to control the associated CSD caption light which indicates low charge oil pressure, and two temperature bulbs sense oil inlet and outlet temperature for the associated CSD oil temperature indicators.

Electrical connections to the disconnect mechanism solenoid, magnetic trimming device, pulse probe, pressure switch, and



- Main Generator Drive - Equipment Location
Figure 002

temperature bulbs are made through plug-and-socket type connectors on the IDG casing.

3. Load Controller (Ref. Fig.001 and 002)

Four load controllers, one associated with each main generator channel, are mounted in the flight compartment racking; Nos.1 and 2 on shelves 2-215 and 1-215 respectively, and Nos.3 and 4 on shelves 1-216 and 2-216 respectively. Each load controller is contained within a rack-mounting case forming a single Elfin box (module) which is in turn installed in an Elfin housing case mounted on the appropriate shelf. The box is secured in the case by two securing screws at the front, and electrical connections are made through an electrical connector at the rear.

The load controller is a phase-sensitive switching demodulator which, in conjunction with a current transformer loop, senses the real-load unbalance between generators operating in parallel and provides a d.c. current to trim the associated CSD governor and reduce real-load division error. The output current is proportional to the real-load unbalance.

Circuits within the load controller increase the d.c. output by a fixed amount to assist in the paralleling of the generator, when the associated parallel-assist switch is operated.

4. CSD Oil Temperature Indicator (Ref. Fig.001 and 003)

The temperature indicator for each CSD is housed in a 2 ATI case mounted on the upper section of the electrical generating control panel (panel 3-214). Electrical connections to the indicator are made through a connector on the rear of the case. The indicator presents oil temperature by means of two pointers read against separate dial scales, INLET and DIFF. Each indicator is powered by a d.c. supply from the main 28 V d.c. busbar, and is connected to two temperature-sensitive resistance bulbs fitted in the associated IDG, one sensing CSD oil inlet temperature and the other CSD oil outlet temperature.

A change in resistance value of either temperature bulb, due to temperature variation, adjusts the condition of the integral circuit which converts the resistance change to a voltage change. The voltage signal resulting from the inlet temperature is used to operate the INLET pointer movement, and the signal resulting from the outlet temperature is compared with the inlet signal and the resulting signal difference is used to operate the DIFF pointer movement. A yellow warning lamp on the front of the instrument is used

to indicate an increase of inlet oil temperature above 145 deg C approximately. The warning lamp filament can be tested/dimmed by the flight compartment lights test and dimming facility (Ref. 33-14-00).

When 28 V d.c. power is applied to the indicator a red and black striped warning flag on the indicator dial is withdrawn from view. In the absence of d.c. power the warning flag is displayed, the DIFF pointer indicates zero and the INLET pointer is withdrawn from the scale at the low end of its range. The indicator presentation is illuminated by integral lighting which operates on a 5 V supply controlled by the instrument lighting system (Ref. 33-17-00).

5. Operation

A. Control and Indication (Ref. Fig. 003)

The CSD disconnect (NORM - DISC) control switches, parallel-assist (P/ASSIST) switches, CSD captions and CSD oil temperature indicators are mounted on the upper section of the electrical generating control panel (panel 3-214).

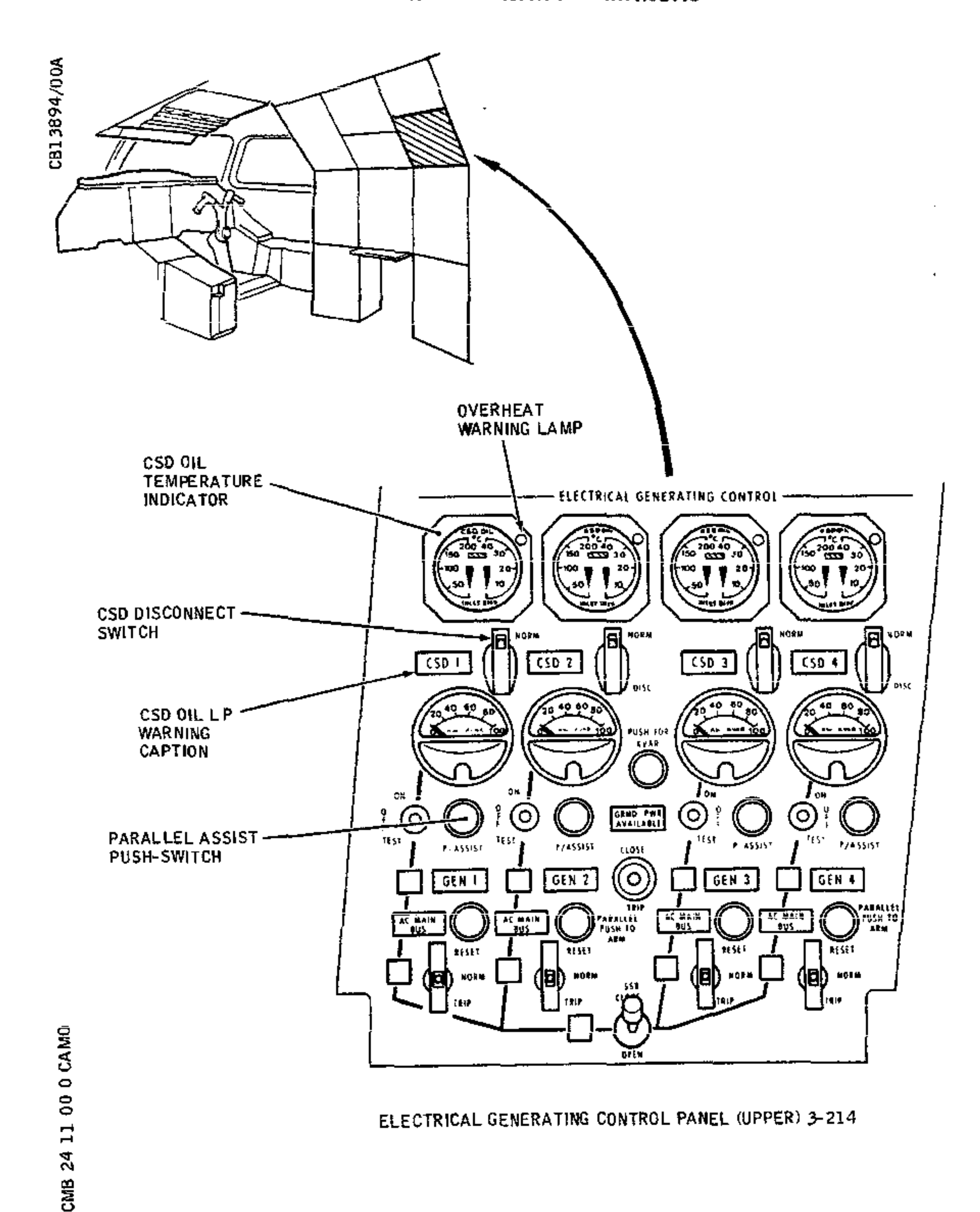
The NORM - DISC control switch for each CSD is of the single-pole change-over type with spring-return and is fitted with a guard. The positions NORM and DISC are effective as follows:

(1) NORM: Guarded. The CSD disconnect solenoid is electrically isolated and, with the drive engaged, the CSD is set for normal operation.

(2) DISC: Spring-return to NORM position. Momentary setting to this position energizes the CSD disconnect solenoid to disengage the CSD drive from the engine drive gear. (Re-engagement of the drive can be effected only by operation of the IDG disconnect reset handle).

The P/ASSIST switch for each channel is of the push, spring-return type which, when operated, increases the CSD output speed by 3 Hz, approximately, to enable two generators to be paralleled when they were previously running in synchronism but at an incorrect phase angle, or running at a frequency difference greater than 4 Hz.

The CSD 1-4 warning captions are illuminated in the event of associated CSD low oil charge pressure, which



ELECTRICAL GENERATING CONTROL PANEL (UPPER) 3-214

- Main Generator Drive - Controls and Indicators
Figure 003

also initiates a master warning. The caption light modules incorporate a press-to-test facility and the filaments in the caption lights can be tested/dimmed by the flight compartment lights test and dimming facility (Ref. 33-14-00).

The CSD oil temperature indicators display inlet (INLET) oil temperature, and the difference (DIFF) between inlet and outlet oil temperature of the associated CSD. The yellow warning lamp on the front of a CSD oil temperature indicator is lit if the oil inlet temperature of the associated CSD increases to a level above 145 deg approximately. The red and black striped warning flag on the indicator dial is displayed when the indicator is not powered.

B. Functional Description (Ref. Fig. 001)

Under normal operating conditions the NORM - DISC switches are at NORM, and each main a.c. generator (IDG) is driven by the associated engine through the integral CSD.

Control of the CSD output speed is automatic under control of the flyweight governor.

Each load controller obtains an excitation voltage, from phase B of the associated generator, and a loop signal from a current transformer (Ref. 24-21-00) located on the same output phase of the generator from which the excitation voltage is obtained. The secondary windings of the current transformers of paralleled generators are connected in series, forming a closed loop, but their separate outputs in the form of load-sharing signals are fed individually to the associated load controllers. Therefore, when the generators are operated in parallel, load-sharing signals from the transformer loop are applied to the associated load controller phase-sensitive switching demodulator network, the d.c. output of which trims the associated CSD flyweight governor to determine precise speed and to ensure equal load sharing between generators.

If a generator is 'off-line', or operating individually, the associated current transformer is short-circuited by main generation system contactors.

Each CSD pulse probe provides a speed signal for generator control purposes. This signal is applied to the control and protection unit (CPU) in the associated generator channel (Ref. 24-21-00).

In the event of a malfunctioning transmission, faulty CSD or generator, disconnection of the drive is effected by momentary setting of the NORM - DISC switch to DISC. Thus energized, the solenoid actuates the CSD disconnect mechanism so that the CSD input shaft clutch is disengaged from the CSD input gear, and the shaft spins freely without rotating the transmission. The CSD will then be held disengaged, irrespective of the setting of the NORM - DISC switch, until re-engagement of the drive is effected by operation of the IDG disconnect reset handle.

It is important to note that a NORM - DISC switch must not be set to DISC when the associated IDG/engine is static. If a NORM - DISC switch is inadvertently set to DISC when the associated IDG/engine is static, the IDG disconnect reset handle must be operated to reset the disconnect mechanism before the engine is started. This action is necessary to avoid damage to the disconnect mechanism.

C. Electrical Power Supplies

The associated services and supply busbars with panel locations are given in Table 1 below.

SERVICE	BUSBAR	CIRCUIT BREAKER PANEL
Nos.1 and 2 CSD oil temperature indicators	'A' main 28 V d.c.	15-215
Nos.3 and 4 CSD oil temperature indicators	'B' main 28 V d.c.	15-216
Nos.1 and 2 CSD disconnect	'A' essential 28 V d.c.	1-213
Nos.3 and 4 CSD disconnect	'B' essential 28 V d.c.	3-213
Nos.1 and 2 CSD warning captions	'A' essential 28 V d.c.	1-213
Nos.3 and 4 CSD warning captions	'B' essential 28 V d.c.	3-213

Electrical Power Supplies

SERVICE	BUSBAR	CIRCUIT BREAKER PANEL

Table 1

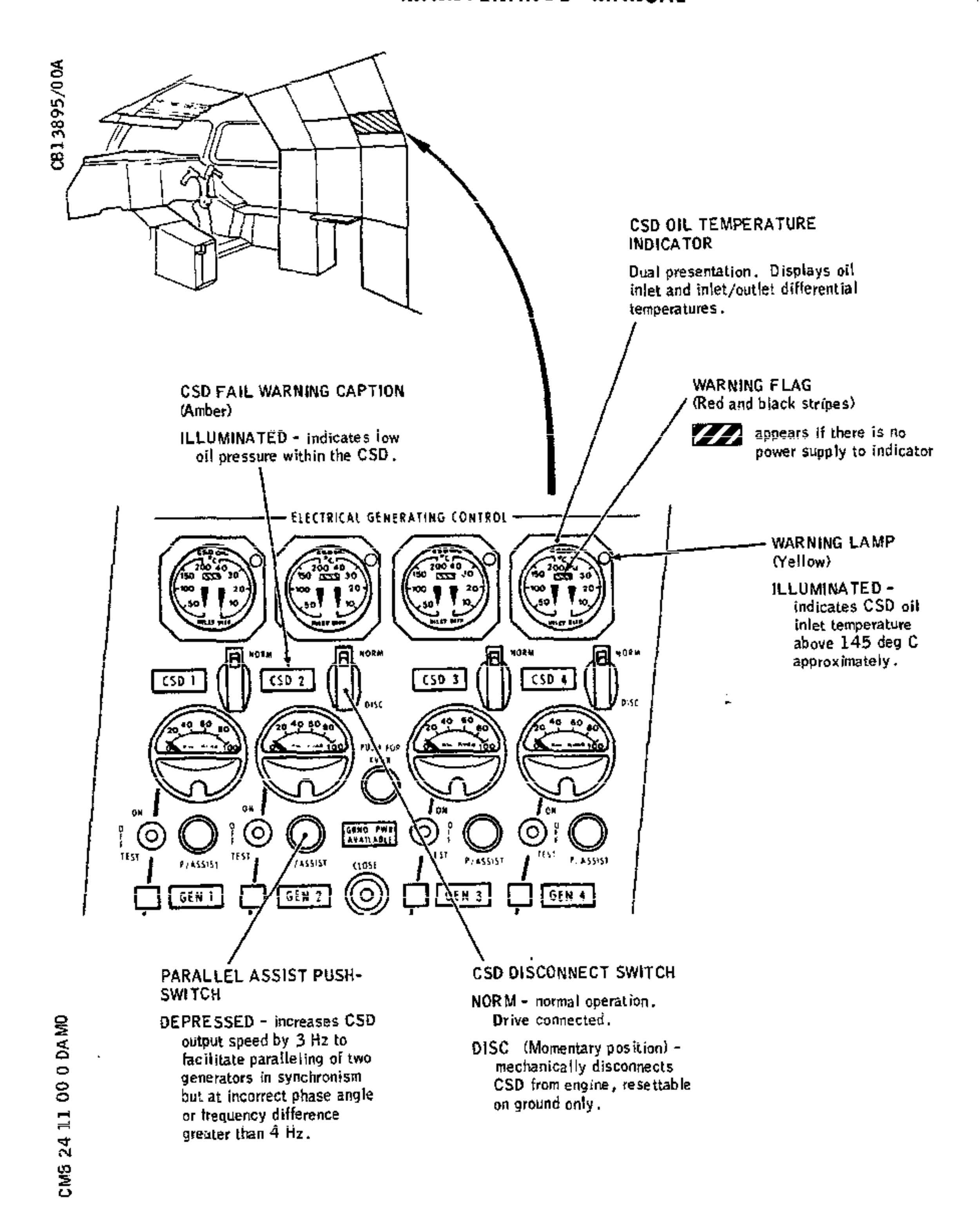
6. System Management (Ref. Fig. 004)

The main generator drive system comprises the constant speed drive (CSD) component of each of the four integrated drive generators (IDGs) in the main a.c. generation system (Ref. 24-21-00), and the equipment, controls and indicators associated with CSD operation. The four IDGs (Nos.1, 2, 3 and 4) are each coupled to a correspondingly-numbered main engine, the integral CSD driving the generator at a constant speed throughout the normal operating speed of the engine.

In normal operation, the system functions automatically so that with two or more generators operating in parallel, the CSD governors are 'trimmed' for precise speed control to ensure equal load sharing between generators. Manual control is available to assist the paralleling of generators, and if necessary, to effect mechanical disconnection of a CSD drive, e.g., in the event of CSD or generator failure. Once disconnected, a CSD drive can be engaged only by the pulling of a disconnect reset handle on the IDG with the engine stopped. The IDG disconnect reset handle is located at the bottom of the IDG and labelled RESET WITH ENGINE STATIC.

It should be noted that damage to the disconnect solenoid may result if the NORM - DISC switch is held at the DISC position for more than 5 s.

It is also important to note that a NORM - DISC switch must not be set to DISC when the associated IDG/engine is static. If a NORM - DISC switch is inadvertently set to DISC when the associated IDG/engine is static, the IDG disconnect reset handle must be operated to reset the disconnect mechanism before the engine is started. This action is necessary to avoid damage to the disconnect mechanism.



CMS 24 11 00 0 DAMD

- Main Generator Drive - System Management
Figure 004

MAIN GENERATOR DRIVE - TROUBLE SHOOTING

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00 AND THE HYDRAULIC SAFETY PRECAUTIONS DETAILED IN 29-00-00.

1. General

Faults are dealt with on a probability basis and identified as a result of testing.

R The defect can be isolated with the aid of trouble shooting procedures (Ref. paras.3., 4., 5., 6., 7. or 8.), and traced through IF OK and IF NOT OK paths to the appropriate charts or other specified rectification action as may be necessary. If a defect occurs, perform the appropriate rectification action, then repeat the operation at which the defect was encountered to ensure that the operation is OK.

Bracketed numbers in the preparation procedures and charts indicate items on the component identification table (Ref. Table 101). The table provides information, including component location, required for rectification. Component location also indicates the possible necessity of repositioning certain items of ground service equipment. Each chart also specifies the ground equipment required for that particular task.

All procedures dealing with trouble shooting are based on the assumption that electrical wiring is serviceable, all associated circuit breakers are set and electrical power is available, unless otherwise stated. If the fault is not rectified, check the wiring in accordance with the Wiring Diagram Manual (Ref. Table 101).

Trouble shooting in this topic is confined to rectifying faults in the constant speed drive (CSD) oil temperature indication and CSD disconnect circuits. Trouble shooting for the CSD, i.e., the transmission component of the integrated drive generator (IDG) is contained in General - Trouble Shooting (Ref. 24-00-00) under the sub-heading 'AC Generation - Using Main Engines'.

The circuits for Nos.1, 2, 3 and 4 generation channels are similar. Therefore, where equipment identical in each channel is involved, trouble shooting for No.1 channel is given by the first component identification reference (Table 101) and for Nos.2, 3 and 4 channels in that order, by the subsequent component references. E.g., on Chart 101 - Renew Indicator (7), (8), (9) or (10) - (7) is in channel 1, (8) is in channel 2, and so on.

2. Preparation

A. Preliminary - Oil Temperature Indication Circuits

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Ensure that the associated circuit breakers are set (Ref. Table 101).

B. Calibration - No.1, No.2, No.3 or No.4 Oil Temperature Indicator

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Ensure that the associated circuit breakers are set (Ref. Table 101).

C. Constant Speed Drive (CSD) Disconnect

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Ensure that the associated circuit breakers are set (Ref. Table 101).

(3) With all four engines stopped, check that the CSD warning (oil low pressure) captions, CSD 1, CSD 2, CSD 3 and CSD 4, are illuminated. If a caption remains extinguished, refer to General - Trouble Shooting (Ref. 24-00-00) under the sub-heading 'AC Generation - Using Main Engines'.

R (4) Start and run the associated engine at ground idle,
R noting the procedures to be carried out if excessive
R CSD OIL INLET temperature is indicated during the
R engine run (Ref. 71-00-00). Check that the associated CSD warning caption is extinguished. If the caption remains illuminated, refer to General - Trouble Shooting (Ref. 24-00-00) under the sub-heading 'AC Generation - Using Main Engines'.

3. Trouble Shooting - Preliminary - Oil Temperature Indication Circuits

```
A.*********************************************
  *Prepare to trouble shoot (Ref. para.2.A.).*
  *Check that the power failure flags on     *
  *Nos.1, 2, 3 and 4 CSD oil temperature     *
  *indicators are not displayed.  IF -       *
  *********************************************
              |    |
              |    |     -----------------------------------
              |    |    |1. Power failure flags are visible |
             OK   NOT OK------|   on Nos.1 and 2 indicators -      |
              |         |   check for 28 V d.c. at terminal |
              |         |   2 of CB (1).  If present, locate|
              |         |   and rectify O/C; if not present,|
              |         |   renew CB (1).                   |
              |         |2. Power failure flags are visible |
              |         |   on Nos.3 and 4 indicators -      |
              |         |   check for 28 V d.c. at terminal |
              |         |   2 of CB (2).  If present, locate|
              |         |   and rectify O/C; if not present,|
              |         |   renew CB (2).                   |
              |         |3. Power failure flag visible on   |
              |         |   No.1, 2, 3 or 4 indicator -      |
              |         |   disconnect connector 1D142-A,   |
              |         |   2D142A, 3D142A or 4D142A, as    |
              |         |   appropriate, at the indicator.  |
              |         |   Check that 28 V d.c. is present |
              |         |   at pin A of 'free' connector.   |
              |         |   If not present, locate and      |
              |         |   rectify O/C; if present, check  |
              |         |   earth return available at pin F.|
              |         |   If available, renew Indicator   |
              |         |   (7), (8), (9) or (10); if not   |
              |         |   available, locate and rectify   |
              |         |   O/C.  Reconnect connector.      |
              |          -----------------------------------
              |
B.*********************************************
  *Check that 'normal' readings are displayed*
  *on the INLET and DIFF scales on Nos.1, 2, *
  *3 and 4 CSD oil temperature indicators.   *
  *IF -                                      *
  *********************************************
                   |
```

```
                  |
                  |
                  |         -----------------------------------
                  |        |1. INLET temperature off-scale     |
NOT OK------|        |   'high' and DIFF temperature off-|
                           |   scale 'low' - Chart 101.        |
                           |2. INLET temperature off-scale     |
                           |   'low' and DIFF temperature off- |
                           |   scale 'high' - Chart 102.       |
                           |3. INLET temperature and DIFF      |
                           |   temperature off-scale 'high' -  |
                           |   Chart 103.                      |
                           |4. INLET temperature 'normal' and  |
                           |   DIFF temperature off-scale 'low'|
                           |   - Chart 104.                    |
                            -----------------------------------
```

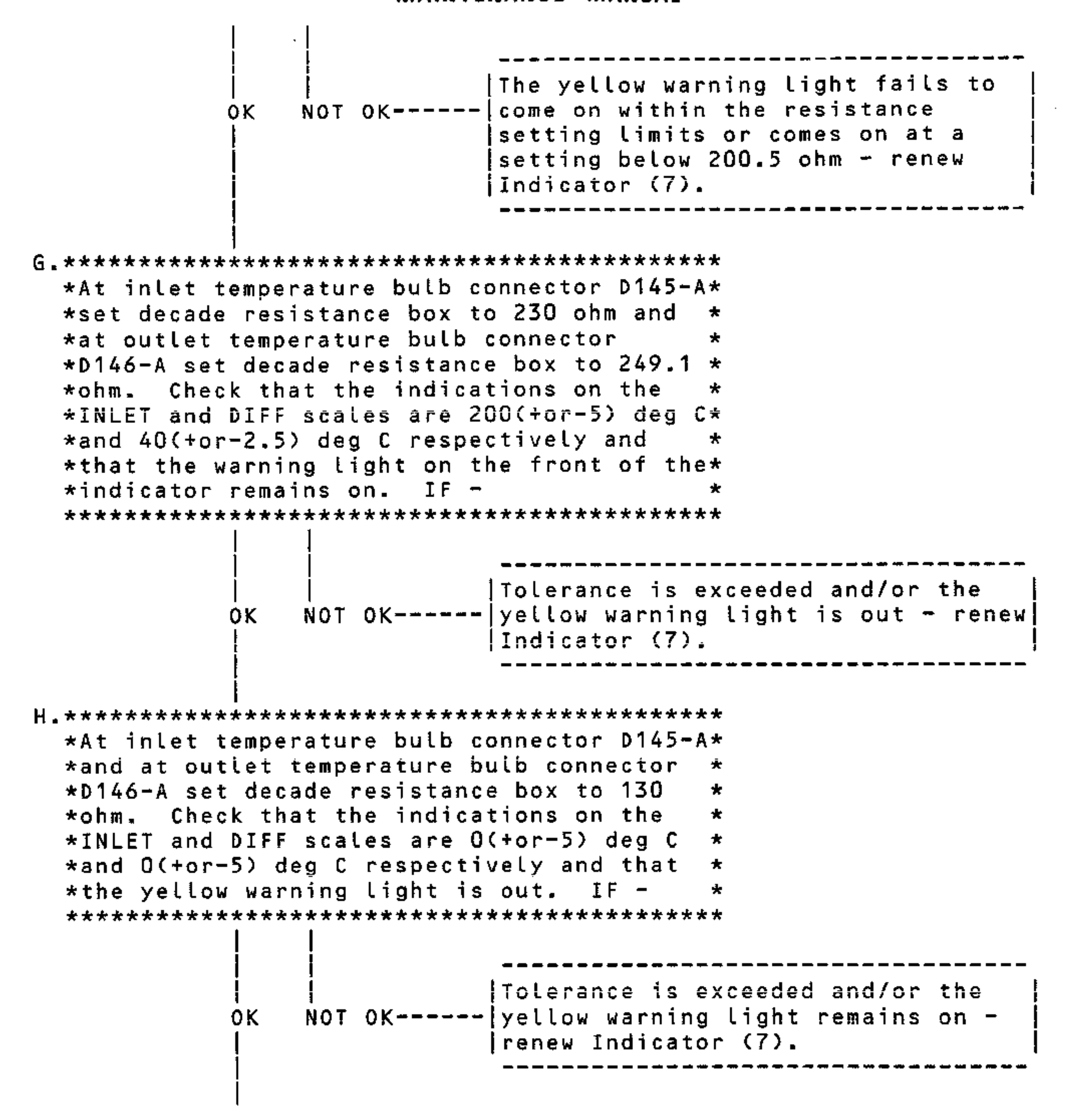
4. Trouble Shooting - Calibration - No.1 CSD Oil Temperature Indicator

WARNING: NOS.1 AND 2 ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

```
A.********************************************
  *Prepare to trouble shoot (Ref. para.2.B.).*
  *Trip and fit a safety clip to CB (1).     *
  *Open the engine bay doors as required to  *
  *gain access to No.1 IDG (Ref. 71-00-00).  *
  *Disconnect electrical connectors D145-A   *
  *and D146-A from the oil inlet and outlet  *
  *temperature probes (bulbs) at No.1 IDG.   *
  *Connect two decade resistance boxes (range*
  *100 to 300 ohm), one between pins A and B *
  *of 'free' connector D145-A and the other  *
  *between pins A and B of 'free' connector  *
  *D146-A.  Set each box to 130 ohm.  Check  *
  *that the power failure warning flag on    *
  *No.1 CSD oil temperature indicator is     *
  *displayed.  IF -                          *
  ********************************************
            |    |
```

```
              |     |
              |     |              ------------------------------------
              |     |             |Power failure warning flag is not  |
              OK    NOT OK------  |displayed - disconnect connector   |
              |                   |1D142-A from Indicator (7).  If    |
              |                   |fault is cleared, renew CB (1) and |
              |                   |reconnect connector 1D142-A.  If   |
              |                   |fault remains, renew Indicator (7).|
              |                    ------------------------------------
              |
B.*********************************************
  *Remove the safety clip and reset CB (1).   *
  *Check that the power failure warning flag *
  *is not displayed and that the indication   *
  *on the INLET scale is 0(±or-5) deg C. IF -*
  *********************************************
              |     |
              |     |              ------------------------------------
              |     |             |Tolerance is exceeded - check that |
              OK    NOT OK------  |the single line resistance between |
              |                   |the inlet temperature bulb         |
              |                   |connector D145-A and the indicator |
              |                   |is 10(+or-0.05) ohm (20 deg C      |
              |                   |nominal ambient temperature).  If  |
              |                   |correct, renew Indicator (7); if   |
              |                   |low - renew Resistance Spool (15); |
              |                   |if high, locate and rectify high   |
              |                   |resistance fault in circuit.       |
              |                    ------------------------------------
              |
C.*********************************************
  *Check that the indication of the DIFF      *
  *scale is 0(+or-5) deg C.  IF -             *
  *********************************************
              |     |
              |     |              ------------------------------------
              |     |             |Tolerance is exceeded - check that |
              OK    NOT OK------  |the single line resistance between |
              |                   |the outlet temperature bulb        |
              |                   |connector D146-A and the indicator |
              |                   |is 10(+or-0.05) ohm (20 deg C      |
              |                   |nominal ambient temperature).  If  |
              |                   |correct, renew Indicator (7); if   |
              |                   |low, renew Resistance Spool (11);  |
              |                   |if high, locate and rectify high   |
              |                   |resistance fault in circuit.       |
              |                    ------------------------------------
              |
```

```
                 |
D.*******************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 180.7 ohm and*
  *at outlet temperature bulb connector      *
  *D146-A set decade resistance box to 190.7 *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 100(+or-5) deg C*
  *and 20(+or-2.5) deg C respectively.  IF - *
  *******************************************
                 |    |
                 |    |           ----------------------------------
                 |    |          |Tolerance is exceeded - renew    |
                OK   NOT OK------|Indicator (7).                   |
                 |                ----------------------------------
                 |
E.*******************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 203   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 145(+or-5) deg C*
  *and 0(+or 2.5) deg C respectively.  IF -  *
  *                                          *
  *NOTE:  The yellow warning light on the    *
  *       front of the oil temperature       *
  *       indicator should come on at an     *
  *       inlet temperature of approx. 145   *
  *       deg C.  See paragraph F., below.   *
  *******************************************
                 |    |
                 |    |           ----------------------------------
                 |    |          |Tolerance is exceeded - renew    |
                OK   NOT OK------|Indicator (7).                   |
                 |                ----------------------------------
                 |
F.*******************************************
  *Vary the resistance box setting at the    *
  *inlet temperature bulb connector D145-A   *
  *and check that the yellow warning light   *
  *comes on at a setting within the range    *
  *200.5 to 205.5 ohm.  IF -                 *
  ******************************************
                 |    |
```



```
        |     |
        |     |          -----------------------------------
        |     |         |The yellow warning light fails to |
        OK    NOT OK------|come on within the resistance     |
        |               |setting limits or comes on at a   |
        |               |setting below 200.5 ohm - renew   |
        |               |Indicator (7).                    |
        |                -----------------------------------
        |
G.*********************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 230 ohm and  *
  *at outlet temperature bulb connector      *
  *D146-A set decade resistance box to 249.1 *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 200(+or-5) deg C*
  *and 40(+or-2.5) deg C respectively and    *
  *that the warning light on the front of the*
  *indicator remains on.  IF -               *
  ********************************************
        |     |
        |     |          -----------------------------------
        |     |         |Tolerance is exceeded and/or the  |
        OK    NOT OK------|yellow warning light is out - renew|
        |               |Indicator (7).                    |
        |                -----------------------------------
        |
H.*********************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 130   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 0(+or-5) deg C  *
  *and 0(+or-5) deg C respectively and that  *
  *the yellow warning light is out.  IF -    *
  ********************************************
        |     |
        |     |          -----------------------------------
        |     |         |Tolerance is exceeded and/or the  |
        OK    NOT OK------|yellow warning light remains on - |
        |               |renew Indicator (7).              |
        |                -----------------------------------
        |
```

```
                 |
I.*******************************************
  *Trip and fit a safety clip to CB (1).     *
  *Disconnect and remove the decade          *
  *resistance boxes from connectors D145A and*
  *D146-A.  Reconnect the connectors to the  *
  *oil inlet and outlet temperature bulbs    *
  *respectively.  Tighten and wire-lock the  *
  *connectors (Ref. Wiring Diagram Manual,   *
  *20-42-48). Remove the safety clip and     *
  *reset CB (1).  Check that the INLET scale *
  *reads approximately the ambient temper-   *
  *ature and the DIFF scale 0(+or-5) deg C.  *
  *Close the engine bay doors (Ref. 71-00-00)*
  *Switch off and disconnect electrical      *
  *ground power as detailed in 24-41-00.     *
  *******************************************
```

5. <u>Trouble Shooting - Calibration - No.2 CSD Oil Temperature Indicator</u>

<u>WARNING:</u> NOS.1 AND 2 ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

```
A.*******************************************
  *Prepare to trouble shoot (Ref. para.2.B.).*
  *Trip and fit a safety clip to CB (1).     *
  *Open the engine bay doors as required to  *
  *gain access to No.2 IDG (Ref. 71-00-00).  *
  *Disconnect electrical connectors D145-A   *
  *and D146-A from the oil inlet and outlet  *
  *temperature probes (bulbs) at No.2 IDG.   *
  *Connect two decade resistance boxes (range*
  *100 to 300 ohm), one between pins A and B*
  *of 'free' connector D145-A and the other  *
  *between pins A and B of 'free' connector  *
  *D146-A.  Set each box to 130 ohm.  Check  *
  *that the power failure warning flag on    *
  *No.2 CSD oil temperature indicator is     *
  *displayed.  IF -                          *
  *******************************************
                |    |
                |    |     ------------------------------------
                |    |    |Power failure warning flag is not   |
                OK   NOT OK------|displayed - disconnect connector   |
                |         |2D142-A from Indicator (8).  If     |
                |         |fault is cleared, renew CB (1) and  |
                |         |reconnect connector 2D142-A.  If    |
                |         |fault remains, renew Indicator (8).|
                |          ------------------------------------
```


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```
                 |
B.*******************************************
  *Remove the safety clip and reset CB (1).  *
  *Check that the power failure warning flag *
  *is not displayed and that the indication  *
  *on the INLET scale is 0(+or-5) deg C. IF -*
  *******************************************
                 |    |
                 |    |              -----------------------------------
                 |    |             |Tolerance is exceeded - check that |
                 OK   NOT OK------- |the single line resistance between |
                 |                  |the inlet temperature bulb         |
                 |                  |connector D145-A and the indicator |
                 |                  |is 10(+or-0.05) ohm (20 deg C      |
                 |                  |nominal ambient temperature).  If  |
                 |                  |correct, renew Indicator (8); if   |
                 |                  |low - renew Resistance Spool (16); |
                 |                  |if high, locate and rectify high   |
                 |                  |resistance fault in circuit.       |
                 |                   -----------------------------------
                 |
C.*******************************************
  *Check that the indication on the DIFF     *
  *scale is 0(+or-5) deg C.  IF -            *
  *******************************************
                 |    |
                 |    |              -----------------------------------
                 |    |             |Tolerance is exceeded - check that |
                 OK   NOT OK------- |the single line resistance between |
                 |                  |the outlet temperature bulb        |
                 |                  |connector D146-A and the indicator |
                 |                  |is 10(±or-0.05) ohm (20 deg C      |
                 |                  |nominal ambient temperature).  If  |
                 |                  |correct, renew Indicator (8);  if  |
                 |                  |low, renew Resistance Spool (12);  |
                 |                  |if high, locate and rectify high   |
                 |                  |resistance fault in circuit.       |
                 |                   -----------------------------------
                 |
D.*******************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 180.7 ohm and*
  *at outlet temperature bulb connector      *
  *D146-A set decade resistance box to 190.7 *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 100(+or-5) deg C*
  *and 20(+or-2.5) deg C respectively.  IF - *
  *******************************************
                 |    |
```

```
             |     |
             |     |                 -----------------------------------
             |     |                |Tolerance is exceeded - renew      |
             OK    NOT OK------     |Indicator (8).                     |
             |                       -----------------------------------
             |
E.********************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 203   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 145(+or-5) deg C*
  *and 0(+or-2.5) deg C respectively.  IF -  *
  *                                          *
  *NOTE:  The yellow warning light on the   *
  *       front of the oil temperature      *
  *       indicator should come on at an    *
  *       inlet temperature of approx. 145  *
  *       deg C.  See paragraph F., below.  *
  ********************************************
             |     |
             |     |                 -----------------------------------
             |     |                |Tolerance is exceeded - renew      |
             OK    NOT OK------     |Indicator (8).                     |
             |                       -----------------------------------
             |
F.********************************************
  *Vary the resistance box setting at the    *
  *inlet temperature bulb connector D145-A   *
  *and check that the yellow warning light   *
  *comes on at a setting within the range    *
  *200.5 to 205.5 ohm.  IF -                 *
  ********************************************
             |     |
             |     |                 -----------------------------------
             |     |                |The yellow warning light fails to  |
             OK    NOT OK------     |come on within the resistance      |
             |                      |setting limits or comes on at a    |
             |                      |setting below 200.5 ohm = renew    |
             |                      |Indicator (8).                     |
             |                       -----------------------------------
             |
```

```
                 |
G.*********************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 230 ohm and  *
  *at outlet temperature bulb connector      *
  *D146-A set decade resistance box to 249.1 *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 200(+or-5) deg C*
  *and 40(+or-2.5) deg C respectively and    *
  *that the warning light on the front of the*
  *indicator remains on.  IF -               *
  ********************************************
                 |    |
                 |    |        -------------------------------------
                 |    |       |Tolerance is exceeded and/or the    |
                 OK   NOT OK------|yellow warning light is out - renew|
                 |            |Indicator (8).                      |
                 |             -------------------------------------
                 |
H.*********************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 130   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 0(+or-5) deg C  *
  *and 0(+or-5) deg C respectively and that  *
  *the yellow warning light is out.  IF -    *
  ********************************************
                 |    |
                 |    |        -------------------------------------
                 |    |       |Tolerance is exceeded and/or the    |
                 OK   NOT OK------|yellow warning light remains on -   |
                 |            |renew Indicator (8).                |
                 |             -------------------------------------
                 |
I.*********************************************
  *Trip and fit a safety clip to CB (1).     *
  *Disconnect and remove the decade resis-   *
  *tance boxes from connectors D145-A and    *
  *D146-A.  Reconnect the connectors to the  *
  *oil inlet and outlet temperature bulbs re-*
  *spectively. Tighten and wire-lock the     *
  *connectors (Ref. Wiring Diagram Manual,   *
  *20-42-48). Remove the safety clip and re- *
  *set CB (1). Check that the INLET scale    *
  *reads approximately the ambient tempera-  *
  *ture and the DIFF scale 0(+or-5) deg C.   *
  *Close engine bay doors (Ref. 71-00-00).   *
  *Switch off and disconnect electrical      *
  *ground power as detailed in 24-41-00.     *
  ********************************************
```

6. Trouble Shooting - Calibration - No.3 CSD Oil Temperature Indicator

WARNING: NOS.3 AND 4 ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

```
A.********************************************
  *Prepare to trouble shoot (Ref. para.2.B.).*
  *Trip and fit a safety clip to CB (2).     *
  *Open the engine bay doors as required to  *
  *gain access to No.3 IDG (Ref. 71-00-00).  *
  *Disconnect electrical connectors D145-A   *
  *and D146-A from the oil inlet and outlet  *
  *temperature probes (bulbs) at No.3 IDG.   *
  *Connect two decade resistance boxes       *
  *(range 100 to 300 ohm), one between pins A*
  *and B of 'free' connector D145-A and the  *
  *other between pins A and B of 'free'      *
  *connector D146-A.  Set each box to 130    *
  *ohm.  Check that the power failure warning*
  *flag on No.3 CSD oil temperature indicator*
  *is displayed.  IF -                       *
  ********************************************
              |    |
              |    |     -----------------------------------
              |    |    |Power failure warning flag is not  |
             OK   NOT OK------|displayed - disconnect connector   |
              |         |3D142-A from Indicator (9).  If    |
              |         |fault is cleared, renew CB (2) and |
              |         |reconnect connector 3D142-A.  If   |
              |         |fault remains, renew Indicator (9).|
              |          -----------------------------------
              |
B.********************************************
  *Remove the safety clip and reset CB (1).  *
  *Check that the power failure warning flag *
  *is not displayed and that the indication  *
  *on the INLET scale is 0(+or-5) deg C. IF -*
  ********************************************
              |    |
```

```
        |     |          ----------------------------------
        |     |         |Tolerance is exceeded - check that |
        OK    NOT OK----|the single line resistance between |
        |               |the inlet temperature bulb         |
        |               |connector D145-A and the indicator |
        |               |is 10(+or-0.05) ohm (20 deg C      |
        |               |nominal ambient temperature).  If  |
        |               |correct, renew Indicator (9);  if  |
        |               |low - renew Resistance Spool (17); |
        |               |if high, locate and rectify high   |
        |               |resistance fault in circuit.       |
        |                ----------------------------------
        |
C.*******************************************
  *Check that the indication on the DIFF    *
  *scale is 0(+or-5) deg C.  IF -           *
  *******************************************
        |     |          ----------------------------------
        |     |         |Tolerance is exceeded - check that |
        OK    NOT OK----|the single line resistance between |
        |               |the outlet temperature bulb        |
        |               |connector D146-A and the indicator |
        |               |is 10(+or-0.05) ohm (20 deg C      |
        |               |nominal ambient temperature).  If  |
        |               |correct, renew Indicator (9);  if  |
        |               |low, renew Resistance Spool (13);  |
        |               |if high, locate and rectify high   |
        |               |resistance fault in circuit.       |
        |                ----------------------------------
        |
D.*******************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 180.7 ohm and*
  *at outlet temperature bulb connector      *
  *D146-A set decade resistance box to 190.7 *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 100(+or-5) deg C*
  *and 20(+or-2.5) deg C respectively.  IF - *
  *******************************************
        |     |
        |     |          ----------------------------------
        |     |         |Tolerance is exceeded - renew      |
        OK    NOT OK----|Indicator (9).                     |
        |                ----------------------------------
        |
```

```
                |
E.*******************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 203   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 145(+or-5) deg C*
  *and 0(+or-2.5) deg C respectively.  IF -  *
  *                                          *
  *NOTE:  The yellow warning light on the    *
  *       front of the oil temperature       *
  *       indicator should come on at an     *
  *       inlet temperature of approx. 145   *
  *       deg C.  See paragraph F., below.   *
  ********************************************
                |    |
                |    |      -----------------------------------
                |    |     |Tolerance is exceeded - renew      |
               OK   NOT OK------|Indicator (9).                |
                |           -----------------------------------
                |
F.*******************************************
  *Vary the resistance box setting at the    *
  *inlet temperature bulb connector D145-A   *
  *and check that the yellow warning light   *
  *comes on at a setting within the range    *
  *200.5 to 205.5 ohm.  IF -                 *
  ********************************************
                |    |
                |    |      -----------------------------------
                |    |     |The yellow warning light fails to  |
               OK   NOT OK------|come on within the resistance |
                |          |setting limits or comes on at a    |
                |          |setting below 200.5 ohm - renew    |
                |          |Indicator (9).                     |
                |           -----------------------------------
                |
G.*******************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 230 ohm and  *
  *at outlet temperature bulb connector      *
  *D146-A set decade resistance box to 249.1 *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 200(+or-5)deg C *
  *and 40(+or-2.5) deg C respectively and    *
  *that the warning light on the front of the*
  *indicator remains on.  IF -               *
  ********************************************
                |    |
```

```
             |    |
             |    |      |Tolerance is exceeded and/or the   |
             OK   NOT OK------|yellow warning light is out - renew|
             |               |Indicator (9).                     |
             |
             |
H.******************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 130   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 0(+or-5) deg C  *
  *and 0(+or-5) deg C respectively and that  *
  *the yellow warning light is out.  IF -    *
  ******************************************
             |    |
             |    |
             |    |      |Tolerance is exceeded and/or the   |
             OK   NOT OK------|yellow warning light remains on -  |
             |               |renew Indicator (9).               |
             |
             |
I.******************************************
  *Trip and fit a safety clip to CB (2).     *
  *Disconnect and remove the decade          *
  *resistance boxes from connectors D145-A   *
  *and D146-A.  Reconnect the connectors to  *
  *the oil inlet and outlet temperature bulbs*
  *respectively.  Tighten and wire-lock the  *
  *connectors (Ref. Wiring Diagram  Manual,  *
  *20-42-48). Remove the safety clip and     *
  *reset CB (2).  Check that the INLET scale *
  *reads approximately the ambient           *
  *temperature and the DIFF scale 0(+or-5)   *
  *deg C.  Close the engine bay doors (Ref.  *
  *71-00-00). Switch off and disconnect      *
  *electrical ground power as detailed in    *
  *24-41-00.                                 *
  ******************************************
```

7. Trouble Shooting - Calibration - No.4 CSD Oil Temperature Indicator

WARNING: NOS.3 AND 4 ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

```
A.*********************************************
  *Prepare to trouble shoot (Ref. para.2.B.).*
  *Trip and fit a safety clip to CB (2).     *
  *Open the engine bay doors as required to  *
  *gain access to No.4 IDG (Ref. 71-00-00).  *
  *Disconnect electrical connectors D145-A   *
  *and D146-A from the oil inlet and outlet  *
  *temperature probes (bulbs) at No.4 IDG.   *
  *Connect two decade resistance boxes       *
  *(range 100 to 300 ohm), one between pins  *
  *A and B of 'free' connector D145-A and    *
  *the other between pins A and B of 'free'  *
  *connector D146-A.  Set each box to 130    *
  *ohm.  Check that the power failure warning*
  *flag on No.4 CSD oil temperature indicator*
  *is displayed.  IF -                       *
  *********************************************
             |    |
             |    |                 -----------------------------------
             |    |                |Power failure warning flag is not |
            OK   NOT OK------------|displayed - disconnect connector  |
             |                     |4D142-A from Indicator (7).  If   |
             |                     |fault is cleared, renew CB (2) and|
             |                     |reconnect connector 4D142-A.  If  |
             |                     |fault remains, renew Indicator    |
             |                     |(10).                             |
             |                      -----------------------------------
             |
B.*********************************************
  *Remove the safety clip and reset CB (2).  *
  *Check that the power failure warning flag *
  *is not displayed and that the indication  *
  *on the INLET scale is 0(+or-5) deg C. IF -*
  *********************************************
             |    |
```

EFFECTIVITY: ALL

R

BA

```
                 |    |
                 |    |             -----------------------------------
                 |    |            |Tolerance is exceeded - check that |
                 OK   NOT OK-------|the single line resistance between |
                 |                 |the inlet temperature bulb         |
                 |                 |connector D145-A and the indicator |
                 |                 |is 10(+or-0.05) ohm (20 deg C      |
                 |                 |nominal ambient temperature).  If  |
                 |                 |correct, renew Indicator (10);  if |
                 |                 |low, renew Resistance Spool (18);  |
                 |                 |if high, locate and rectify high   |
                 |                 |resistance fault in circuit.       |
                 |                  -----------------------------------
                 |
C.*******************************************
  *Check that the indication on the DIFF    *
  *scale is 0(+or-5) deg C.  IF -           *
  *******************************************
                 |    |
                 |    |             -----------------------------------
                 |    |            |Tolerance is exceeded - check that |
                 OK   NOT OK-------|the single line resistance between |
                 |                 |the outlet temperature bulb        |
                 |                 |connector D146-A and the indicator |
                 |                 |is 10(+or-0.05) ohm (20 deg C      |
                 |                 |nominal ambient temperature).  If  |
                 |                 |correct, renew Indicator (10); if  |
                 |                 |low, renew Resistance Spool (14);  |
                 |                 |if high, locate and rectify high   |
                 |                 |resistance fault in circuit.       |
                 |                  -----------------------------------
                 |
D.*******************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 180.7 ohm and*
  *at outlet temperature bulb connector     *
  *D146-A set decade resistance box to 190.7 *
  *ohm.  Check that the indications on the  *
  *INLET and DIFF scales are 100(+or-5) deg C*
  *and 20(+or-2.5) deg C respectively.  IF - *
  *******************************************
                 |    |
                 |    |             -----------------------------------
                 |    |            |Tolerance is exceeded - renew      |
                 OK   NOT OK-------|Indicator (10).                    |
                 |                  -----------------------------------
                 |
```

```
                 |
E.*******************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 203   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 145(+or-5) deg C*
  *and 0(+or-2.5) deg C respectively.  IF -  *
  *                                          *
  *NOTE:  The yellow warning light on the    *
  *       front of the oil temperature       *
  *       indicator should come on at an     *
  *       inlet temperature of approx. 145   *
  *       deg C.  See paragraph F., below.   *
  ********************************************
                 |    |
                 |    |            ------------------------------------
                 |    |           |Tolerance is exceeded - renew       |
                OK   NOT OK------|Indicator (10).                     |
                 |                 ------------------------------------
                 |
F.*******************************************
  *Vary the resistance box setting at the    *
  *inlet temperature bulb connector D145-A   *
  *and check that the yellow warning light   *
  *comes on at a setting within the range    *
  *200.5 to 205.5 ohm.  IF -                 *
  ********************************************
                 |    |
                 |    |            ------------------------------------
                 |    |           |The yellow warning light fails to   |
                OK   NOT OK------|come on within the resistance       |
                 |                |setting limits or comes on at a     |
                 |                |setting below 200.5 ohm - renew     |
                 |                |Indicator (10).                     |
                 |                 ------------------------------------
                 |
```

```
                |
G.*********************************************
  *At inlet temperature bulb connector D145-A*
  *set decade resistance box to 230 ohm and  *
  *at outlet temperature bulb connector      *
  *D146-A set decade resistance box to 249.1 *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 200(+or-5) deg C*
  *and 40(+or-2.5) deg C respectively and    *
  *that the warning light on the front of the*
  *indicator remains on.  IF -               *
  ********************************************
                |    |
                |    |           ------------------------------------
                |    |          |Tolerance is exceeded and/or the   |
                OK   NOT OK------|yellow warning light is out - renew|
                |               |Indicator (10).                    |
                |                ------------------------------------
                |
H.*********************************************
  *At inlet temperature bulb connector D145-A*
  *and at outlet temperature bulb connector  *
  *D146-A set decade resistance box to 130   *
  *ohm.  Check that the indications on the   *
  *INLET and DIFF scales are 0(+or-5) deg C  *
  *and 0(+or-5) deg C respectively and that  *
  *the yellow warning light is out.  IF -    *
  ********************************************
                |    |
                |    |           ------------------------------------
                |    |          |Tolerance is exceeded and/or the   |
                OK   NOT OK------|yellow warning light remains on -  |
                |               |renew Indicator (10).              |
                |                ------------------------------------
                |
I.*********************************************
  *Trip and fit a safety clip to CB (2).     *
  *Disconnect and remove the decade          *
  *resistance boxes from connectors D145-A   *
  *and D146-A.  Reconnect the connectors to  *
  *the oil inlet and outlet temperature bulbs*
  *respectively.  Tighten and wire-lock the  *
  *connectors (Ref. Wiring Diagram Manual,   *
  *20-42-48).  Remove the safety clip and    *
  *reset CB (2).  Check that the INLET scale *
  *reads approximately the ambient           *
  *temperature and the DIFF scale 0(+or-5)   *
  *deg C.  Close the engine bay doors (Ref.  *
  *71-00-00). Switch off and disconnect      *
  *electrical ground power as detailed in    *
  *24-41-00.                                 *
```

8. Trouble Shooting - Constant Speed Drive (CSD) Disconnect

CAUTION: DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

```
A.*******************************************
  *Prepare to trouble shoot (Ref. para.2.C.).*
  *Set the CSD disconnect switch No.1, 2, 3  *
  *or 4 to the "DISC" position and then      *
  *release it.  Check that the associated    *
  *CSD warning (oil low pressure) caption is *
  *illuminated, indicating that the IDG is   *
  *disconnected.  IF -                       *
  *******************************************
             |    |
             |    |            -----------------------------------
             |    |           |1. CSD warning caption remains     |
            OK   NOT OK-------|   extinguished - Chart 105.       |
             |                 -----------------------------------
             |
B.*******************************************
  *Shut down the engine (Ref. Chap.71) and   *
  *reset the IDG disconnect mechanism as     *
  *detailed in Adjustment/Test.              *
  *******************************************
```

```
********************************
*CSD 'INLET' TEMPERATURE OFF-  *
*SCALE 'HIGH' AND 'DIFF' -     *
*TEMPERATURE OFF-SCALE 'LOW'   *
*WITH GROUND POWER AVAILABLE   *
*AND ALL ENGINES STOPPED.      *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
CONTINUITY TESTER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

```
 ----------------     ----------------         ----------------
|Connect and     |   |Disconnect con- |       |Renew CSD Oil   |
|switch on elec- |---|nector D145-A at|-YES-- |Temperature Bulb|
|trical ground   |   |IDG and link ter-|      |(27),(28),(29) or|
|power; all      |   |minals A and B on|      |(30). Remove    |
|engines stopped.|   |'free' connector.|      |link.           |
 ----------------    |Check that INLET |       ----------------
                     |temperature reads|
                     |'low' and DIFF   |
                     |temperature reads|
                     |'high'.          |
                      ----------------
                             |
                             NO
                             |
                      ----------------         ----------------
                     |Remove link and |       |Renew Resistance|
                     |reconnect con-  |-NO--  |Spool (15),(16),|
                     |nector D145-A.  |       |(17) or (18).   |
                     |Tighten and wire-|       ----------------
                     |lock the con-   |
                     |nector (Ref.    |
                     |Wiring Diagram  |
                     |Manual, 20-42-48)|
                     |Check Resistance|
                     |Spool (15),(16),|
                     |(17) or (18) for|
                     |continuity.     |
                      ----------------
                             |
                            YES
                             |
                      --------------------
                     |*Renew Indicator (7),|
                     |(8),(9) or (10).     |
                      --------------------
```

Chart 101

```
********************************
*CSD 'INLET' TEMPERATURE OFF-  *
*SCALE 'LOW' AND 'DIFF'        *
*TEMPERATURE OFF-SCALE 'HIGH'  *
*WITH GROUND POWER AVAILABLE   *
*AND ALL ENGINES STOPPED.      *
********************************
```

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
INSULATION RESISTANCE TESTER	-

```
 ----------------       ---------------              ----------------
|Connect and     |     |Disconnect con- |           |Renew CSD Oil   |
|switch on elec- |-----|nector D145-A at |-YES-|Temperature Bulb |
|trical ground   |     |IDG. Check that  |      |(27),(28),(29) or|
|power; all      |     |INLET temperature|      |(30). Reconnect  |
|engines stopped.|     |reads 'high' and |      |connector D145-A.|
 ----------------      |DIFF temperature |      |Tighten and wire-|
                       |reads 'low'.     |      |lock the con-    |
                        ================        |nector (Ref.     |
                               |                |Wiring Diagram   |
                               NO               |Manual, 20-42-48)|
                               |                 ----------------
                        ---------------         ----------------
                       |Disconnect con-  |     |Renew Indicator  |
                       |nector 1D142-A,  |-NO-|(7),(8),(9) or   |
                       |2D142-A,3D142 or |     |(10). Reconnect  |
                       |4D142-A at CSD   |     |connector D145-A.|
                       |oil temperature  |     |Tighten and wire-|
                       |indicator. Check |     |lock the connector|
                       |for short circuit|     |(Ref. Wiring     |
                       |between pins H   |     |Diagram Manual,  |
                       |and D at 'free'  |     |20-42-28).       |
                       |connector.       |      ================
                        ---------------
                               |
                               YES
                               |
                        -----------------------
                       |Locate and rectify short|
                       |circuit. Reconnect con- |
                       |nectors D145-A and      |
                       |1D142-A, 2D142-A,       |
                       |3D142-A or 4D142-A.     |
                       |Tighten and wire-lock   |
                       |connector D145-A (Ref.  |
                       |Wiring Diagram Manual,  |
                       |20-42-48).              |
                        -----------------------
```

Chart 102

CSD 'INLET' TEMPERATURE AND 'DIFF' TEMPERATURE OFF-SCALE 'HIGH' WITH GROUND POWER AVAILABLE AND ALL ENGINES STOPPED.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
CONTINUITY TESTER	-

NOTE: Before renewal of components (*), check the associated wiring for continuity.

1. Connect and switch on electrical ground power; all engines stopped.
2. Disconnect connector D146-A at IDG and link terminal A and B on 'free' connector. Check that DIFF temperature reads 'low' and INLET temperature reads correctly.
   - YES: Renew CSD Oil Temperature Bulb (31),(32),(33) or (34). Remove link.
   - NO: Remove link and reconnect connector D146-A. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48) Check resistance spool (11),(12),(13) or (14) for continuity.
     - NO: Renew Resistance Spool (11),(12), (13) or (14).
     - YES: *Renew Indicator (7),(8),(9) or (10).

Chart 103

CSD 'INLET' TEMPERATURE 'NORMAL' AND 'DIFF' TEMPERATURE OFF-SCALE 'LOW' WITH GROUND POWER AVAILABLE AND ALL ENGINES STOPPED.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
INSULATION RESISTANCE TESTER	-

1. Connect and switch on electrical ground power; all engines stopped.
2. Disconnect connector D146-A at IDG. Check that INLET and DIFF temperatures read 'high'.
   - YES: Renew CSD Oil Temperature Bulb (27),(28),(29) or (30).
   - NO: go to 3.
3. Disconnect connector 1D142-A, 2D142-A,3D142-A or 4D142-A at CSD indicator. Check for short circuit between pins H and G at 'free' connector.
   - NO: Renew Indicator (7),(8),(9) or (10). Reconnect connector D146-A. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48)
   - YES: Locate and rectify short circuit. Reconnect connectors D146-A and 1D142-A, 2D142-A, 3D142-A or 4D142-A. Tighten and wire-lock connector D146-A (Ref. Wiring Diagram Manual, 20-42-48).

Chart 104

CSD WARNING CAPTION REMAINS EXTINGUISHED WHEN THE CSD DISCONNECT SWITCH IS SET TO 'DISC' WITH ASSOCIATED ENGINE RUNNING.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND SUPPLY	-
MULTIMETER	-

NOTE: Before renew of components (*), check the associated wiring for continuity.

1. Connect and switch on electrical ground power; all engines stopped.
2. Disconnect the solenoid connector from the IDG, i.e., connector 1X1-D from No.1 IDG, connector 2X1-D from No.2 IDG, connector 3X1-D from No.3 IDG, or connector 4X1-D from No.4 IDG. Hold the CSD disconnect switch at the "DISC" position and check that 28 V d.c. is available at pin B of the 'free' connector.
   - NO: *Renew CSD Disconnect Switch (19),(20),(21) or (22). Reconnect connector 1X1-D, 2X1-D, 3X1-D or 4X1-D Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).
   - YES: Check that an earth potential is available at pin A of 'free' connector.
     - YES: Renew IDG (23),(24), (25) or (26).
     - NO: Locate and rectify O/C. Reconnect connector 1X1-D, 2X1-D, 3X1-D or 4X1-D. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual 20-42-48).

Chart 105

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(1) Circuit breaker 28 V	-	15-215	D140	Map ref.D2	24-50-00 R/I	24-11-01
R (2) Circuit breaker 28 V	-	15-216	D141	Map ref.C25	24-50-00 R/I	24-11-03
(3) Circuit breaker 28 V	-	1-213	1X310	Map ref.R7	24-50-00 R/I	24-11-01
(4) Circuit breaker 28 V	-	1-213	2X310	Map ref.R8	24-50-00 R/I	24-11-02
(5) Circuit breaker 28 V	-	3-213	3X310	Map ref.G8	24-50-00 R/I	24-11-03
(6) Circuit breaker 28 V	-	3-213	4X310	Map ref.G9	24-50-00 R/I	24-11-04
(7) No.1 CSD oil temperature indicator	-	3-214	1D142	3CM station	24-00-00 R/I	24-11-01
(8) No.2 CSD oil temperature indicator	-	3-214	2D142	3CM station	24-00-00 R/I	24-11-02
(9) No.3 CSD oil temperature indicator	-	3-214	3D142	3CM station	24-00-00 R/I	24-11-03
(10) No.4 CSD oil temperature indicator	-	3-214	4D142	3CM station	24-00-00 R/I	24-11-04
(11) Resistance spool (No.1 indicator - outlet bulb)	-	9-214	1D143	3CM station	24-11-00 R/I	24-11-01
(12) Resistance spool (No.2 indicator - outlet bulb)	-	9-214	2D143	3CM station	24-11-00 R/I	24-11-02
(13) Resistance	-	9-214	3D143	3CM station	24-11-00	24-11-03

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
spool (No.3 indicator - outlet bulb)					R/I	
(14) Resistance spool (No.4 indicator - outlet bulb)	-	9-214	4D143	3CM station	24-11-00 R/I	24-11-04
(15) Resistance spool (No.1 indicator - inlet bulb)	-	9-214	1D144	3CM station	24-11-00 R/I	24-11-01
(16) Resistance spool (No.2 indicator - inlet bulb)	-	9-214	2D144	3CM station	24-11-00 R/I	24-11-02
(17) Resistance spool (No.3 indicator - inlet bulb)	-	9-214	3D144	3CM station	24-11-00 R/I	24-11-03
(18) Resistance spool (No.4 indicator - inlet bulb)	-	9-214	4D144	3CM station	24-11-00 R/I	24-11-04
(19) No.1 CSD disconnect switch	-	3-214	1X311	3CM station	24-00-00 R/I	24-11-01
(20) No.2 CSD disconnect switch	-	3-214	2X311	3CM station	24-00-00 R/I	24-11-02
(21) No.3 CSD disconnect switch	-	3-214	3X311	3CM station	24-00-00 R/I	24-11-03
(22) No.4 CSD disconnect switch	-	3-214	4X311	3CM station	24-00-00 R/I	24-11-04

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
(23) No.1 IDG	-	415	1X1	No.1 engine RH acces- sory gearbox	24-11-11 R/I	24-21-02
(24) No.2 IDG	-	426		No.2 engine RH acces- sory gearbox	24-11-11 R/I	24-21-02
(25) No.3 IDG	-	435	3X1	No.3 engine RH acces- sory gearbox	24-11-11 R/I	24-21-02
(26) No.4 IDG	-	446	4X1	No.4 engine RH acces- sory gearbox	24-11-11 R/I	24-21-02
(27) No.1 CSD oil temperature bulb (inlet)	-	415	1D145	Part of IDG	24-11-11 R/I	24-11-01
(28) No.2 CSD oil temperature bulb (inlet)	-	426	2D145	Part of IDG	24-11-11 R/I	24-11-02
(29) No.3 CSD oil temperature bulb (inlet)	-	435	3D145	Part of IDG	24-11-11 R/I	24-11-03
(30) No.4 CSD oil temperature bulb (inlet)	-	446	4D145	Part of IDG	24-11-11 R/I	24-11-04
(31) No.1 CSD oil temperature bulb (outlet)	-	415	1D146	Part of IDG	24-11-11 R/I	24-11-01
(32) No.2 CSD oil temperature bulb (outlet)	-	426	2D146	Part of IDG	24-11-11 R/I	24-11-02
(33) No.3 CSD	-	435	3D146	Part of	24-11-11	24-11-03

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
oil temperature bulb (outlet)				IDG	R/I	
(34) No.4 CSD oil temperature bulb (outlet)	-	446	4D146	Part of IDG	24-11-11 R/I	24-11-04

Component Identification
Table 101

MAIN GENERATOR DRIVE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains instructions for the removal and installation of minor electrical components associated with the main generator drive system, comprising eight adjustable resistance spools employed in the oil temperature indication circuits. Instructions for the removal and installation of other minor electrical components associated with this system, located on the electrical generating management control panels, are contained in 24-00-00.

The adjustable resistance spools are fitted to terminal blocks mounted on the vertical panel of the upper section of the third crew member's (3CM) station secondary structure, behind the 3CM management panel, 2-214. Access to the spools is gained by lowering panel 2-214 on its hinges.

Before installing a replacement resistance spool, the new spool must be adjusted so that, when installed, the single line resistance between the appropriate temperature bulb and the associated oil temperature indicator measures 10(±0.05) ohm, at a nominal ambient temperature of 20 deg C.

2. Resistance Spool (Ref. Fig. 401)

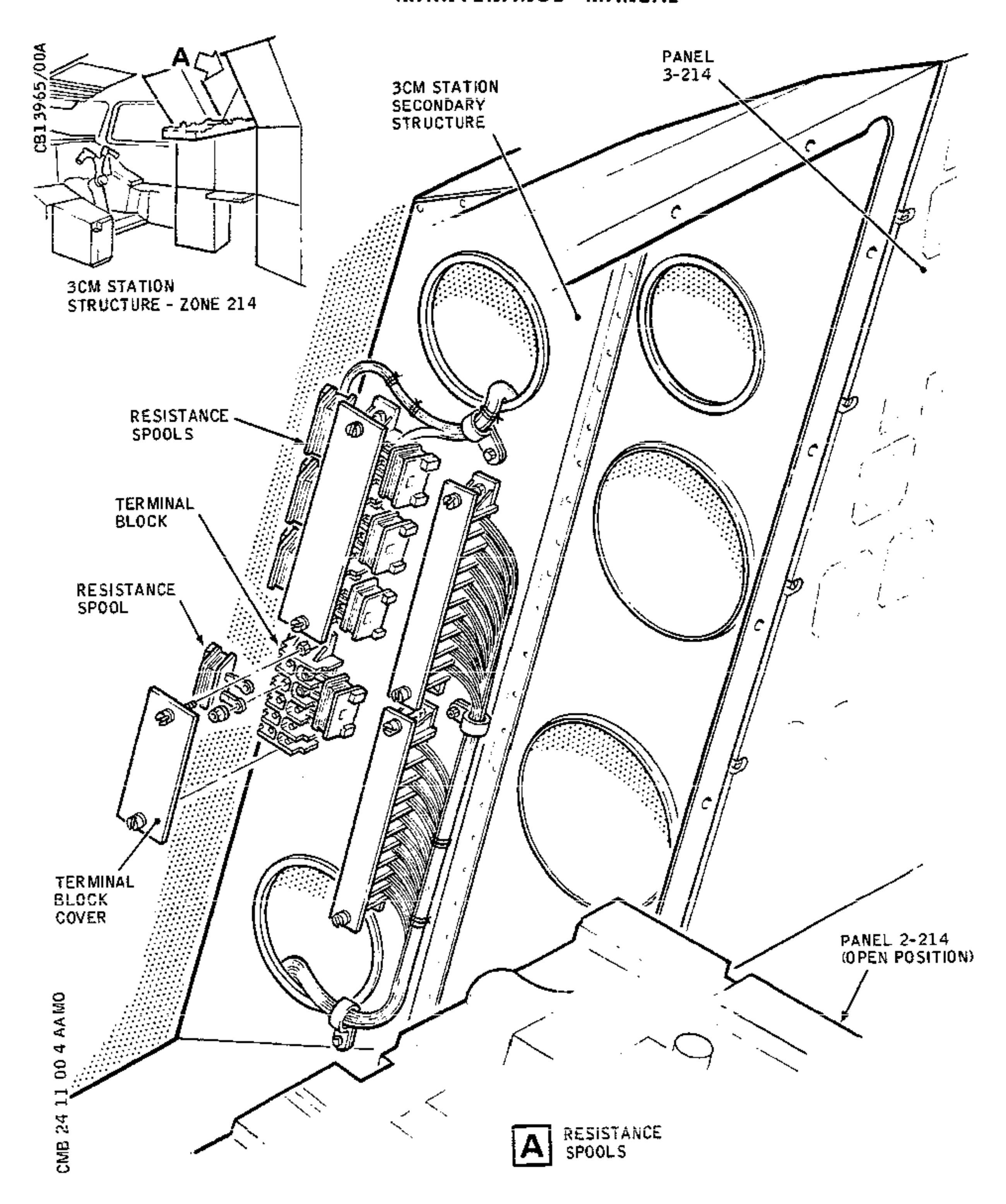
A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 12 to 14 lbf in (0.137 to 0.160 mdaN)	-
Multimeter	-
Locking wire, 0.036 in (0.91 mm) dia.	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Gain access to the resistance spool on the 3CM



Resistance Spool - Installation
Figure 401

station secondary structure, by releasing the quick-release fasteners securing the 3CM management panel, 2-214, pressing in the spring retaining clips and lowering the panel on its hinges.

C. Remove

(1) Remove the terminal block cover from the appropriate terminal block.

(2) Disconnect the resistance spool terminals from the terminal studs and remove the spool from the terminal block.

D. Prepare to Install

(1) Comply with the electrical safety precautions.

(2) Open the engine bay doors, as required, to gain access to the appropriate integrated drive generator (IDG) (Ref. 71-00-00).

(3) Disconnect the electrical connector, D145-A or D146-A, from the oil inlet or oil outlet temperature probe, as applicable, at the IDG.

(4) At the upper electrical generating control panel, 3-214, release the quick-release fasteners, press in the spring retaining clips and lower the panel on its hinges to gain access to the rear of the CSD oil temperature indicator.

(5) Disconnect the electrical connector from the appropriate CSD oil temperature indicator.

(6) At the terminal block on the 3CM station secondary structure, link the two resistance spool connection terminals in the appropriate oil temperature indication circuit.

(7) Measure the single line resistance between pin A of free connector D145-A or D146-A, as applicable, and pin D (inlet temperature) or pin G (outlet temperature) of the associated CSD oil temperature indicator free connector. Record the resistance.

(8) Measure the resistance of the replacement spool. Record the resistance.

(9) If necessary, adjust the resistance of the spool so that the sum total of the single line resistance and

the spool resistance equals 10(±0.05) ohm, in a nominal ambient temperature of 20 deg C.

(10) At the terminal block, remove the link from the terminals.

(11) Carefully bend the resistance spool terminal lugs, at about mid-point, to an upward angle of 15 deg, approximately, to the spool body.

E. Install

(1) Comply with the electrical safety precautions.

(2) Connect the resistance spool terminals to the terminal studs, ensuring that the connections are made in accordance with the applicable wiring diagram. Verify that the body of the spool is clear of the surrounding structure. If necessary, adjust the setting of the terminal lug angle until clearance is obtained.

(3) Torque-tighten the terminal nuts to between 12 and 14 lbf in (0.137 and 0.160 mdaN).

(4) Refit the terminal cover to the terminal block.

F. Conclusion

(1) Close the 3CM management panel, 2-214, and secure it with the quick-release fasteners.

(2) Connect the electrical connector to the appropriate CSD oil temperature indicator, ensuring that the mating surfaces are clean and undamaged.

(3) Close the upper electrical generating control panel, 3-214, and secure it with the quick-release fasteners.

(4) Connect the electrical connector to the appropriate oil temperature probe, ensuring that the mating surfaces are clean and undamaged.

(5) Tighten and wire-lock the electrical connector (Ref. Wiring Diagram Manual, 20-42-48).

(6) Make available electrical ground power as detailed in 24-41-00.

(7) Check the operation of the resistance spool by
R carrying out a calibration test of the associated

R IDG oil temperature indication circuit (Ref. Adjustment/Test).

(8) Close the engine bay doors (Ref. 71-00-00).

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MAIN GENERATOR DRIVE - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

CAUTION: IF AN IDG DISCONNECT (CSD NORM - DISC) SWITCH IS INADVERTENTLY SET TO 'DISC' WHEN THE ASSOCIATED IDG/ENGINE IS STATIC, THE IDG DISCONNECT RESET HANDLE MUST BE OPERATED TO RESET THE DISCONNECT MECHANISM. THIS ACTION IS NECESSARY TO AVOID DAMAGE TO THE DISCONNECT MECHANISM.

NOTE: On the electrical generating control panel, the abbreviation CSD (constant speed drive) is used on associated control and indication equipment to identify the transmission component of the IDG (integrated drive generator) in each main generation channel.

This topic contains the Main Generator Drive System Test, (Ref. para.2.), the procedures for resetting an IDG after disconnection being self-contained under a separate heading (Ref. para.3.).

For convenience of application, the System Test is divided into a series of tests identified under separate sub-headings as follows:-

Preliminary - CSD Oil Temperature Indication Circuits

Calibration - Nos.1 and 2 CSD Oil Temperature Indication Circuits

Calibration - Nos.3 and 4 CSD Oil Temperature Indication Circuits

Test and Adjust IDG

The procedures given under the heading 'Test and Adjust IDG' comprise the operations of IDG testing and adjustment required to ensure that the speed and frequency of the generator are controlled within prescribed limits and that the IDG disconnect facility is effective. These IDG test and adjustment operations are complete and self-contained for application to an IDG in any one of the four main generation channels.

Tests of IDG control in load sharing functions require the paralleling of two or more main generators; such tests are

contained in the System Test of the main generation system (Ref. 24-21-00, Adjustment/Test).

Operational and Functional Tests are not considered necessary since these are automatically satisfied by the checks and drills required for the running of the main engines. The Power Plant Adjustment/Test (Ref. 71-00-00) also includes an IDG disconnect check.

At the conclusion of individual tests certain operations, e.g., switching off electrical ground power, may be omitted, provided that a sequential test validates the omission.

2. System Test

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT TEST EQUIPMENT TO THE ELECTRICAL CONNECTORS.

A. Equipment and Materials

DESCRIPTION	PART NO.
Equipment required for Tests C. and D.	
Circuit breaker safety clips	-
Decade resistance boxes, range 100 to 250 ohm (2)	-
Equipment required for Test E.	
Precision-grade a.c. voltmeter, range 110 to 125 V a.c.	-
Precision-grade frequency meter, range 350 to 450 Hz	-
Torque spanner, 0 to 2.1 lbf in (0.000 to 0.024 mdaN)	-
Torque spanner, 38 to 42 lbf in (0.430 to 0.475 mdaN).	-

B. Test - Preliminary - CSD Oil Temperature Indication Circuits

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(2) Test

(a) Check at Nos.1, 2, 3 and 4 CSD oil temperature indicators that -

a1) the power failure flag is not visible, and

a2) the expected readings are displayed on the INLET and DIFF scales.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

C. Calibration - Nos.1 and 2 CSD Oil Temperature Indication Circuits

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(2) Test

(a) Trip the ENG 1 & 2 CSD OIL TEMP IND circuit breaker D140 on panel 15-215, map ref.D2. and fit a safety clip.

(b) On the electrical generating control panel, observe Nos.1 and 2 CSD oil temperature indicators and check that each displays a red and black striped flag (power supply failure flag) at the aperture in the upper part of the dial.

(c) Open the engine bay doors as required to gain access to the CSD oil inlet and outlet temperature probes (bulbs) located at the bottom of No.1 IDG (Ref. 71-00-00). Disconnect -

c1) the electrical connector at the oil inlet

temperature probe D145, and

c2) the electrical connector at the oil outlet temperature probe D146.

(d) Connect two decade resistance boxes, one between pins A and B of the oil inlet temperature probe 'free' connector D145-A and the other between pins A and B of the oil outlet temperature probe 'free' connector D146-A. Set each box at 130 ohm.

(e) Remove the safety clip and reset the ENG 1 & 2 OIL TEMP IND circuit breaker D140 on panel 15-215, map ref.D2.

(f) Carry out the applicable operations detailed in Table 501 as applied to No.1 IDG oil inlet and outlet temperature probes and No.1 CSD oil temperature indicator.

(g) Trip the ENG 1 & 2 CSD OIL TEMP IND circuit breaker D140 on panel 15-215, map ref.D2, and fit a safety clip.

(h) Disconnect and remove the decade resistance box from the 'free' connector D145-A and reconnect the connector to the oil inlet temperature probe D145, ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

(i) Disconnect and remove the decade resistance box from the 'free' connector D146-A and reconnect the connector to the oil outlet temperature probe D146, ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

(j) Open the engine bay doors as required to gain access to the CSD oil inlet and outlet temperature probes (bulbs) located at the bottom of No.2 IDG. Disconnect -

j1) the electrical connector at the oil inlet temperature probe D145, and

j2) the electrical connector at the oil outlet temperature probe D146.

(k) Connect two decade resistance boxes, one between

pins A and B of the oil inlet temperature probe 'free' connector D145-A and the other between pins A and B of the oil outlet temperature probe 'free' connector D146-A. Set each box at 130 ohm.

(l) Remove the safety clip and reset the ENG 1 & 2 CSD OIL TEMP IND circuit breaker D140, on panel 15-215, map ref.D2.

(m) Carry out the applicable operations detailed in Table 501 as applied to No.2 IDG oil inlet and outlet temperature probes and No.2 CSD oil temperature indicator.

(n) Trip the ENG 1 & 2 CSD OIL TEMP IND circuit breaker D140 on panel 15-215, map ref.D2, and fit a safety clip.

(o) Repeat operations (h) and (i).

(p) Check that the power supply failure flag is fully visible at the dials of both No.1 and No.2 oil temperature indicators.

(q) Remove the safety clip and reset the ENG 1 & 2 OIL TEMP IND circuit breaker D140 on panel 15-215, map ref.D2.

(r) Check that the power supply failure flag has disappeared at the dials of both No.1 and No.2 CSD oil temperature indicators.

(3) Conclusion

(a) Close the engine bay doors (Ref.71-00-00).

(b) Switch off and disconnect electrical ground power as detailed in 24-41-00).

OPERATION	INDICATION		
	SUPPLY FAILURE FLAG	INLET TEMP. (deg C)	DIFF. TEMP. (deg C)
1. At probe connector D145-A set decade resistance box to 130 ohm and at probe connector	Not visible	0(+or-5)	0(+or-5)

OPERATION	INDICATION SUPPLY FAILURE FLAG	INLET TEMP. (deg C)	DIFF. TEMP. (deg C)
D146-A, set decade resistance box to 130 ohm.			
2. At probe connector D145-A set decade resistance box to 180.7 ohm and at probe connector D146-A set decade resistance box to 190.7 ohm.	Not visible	100(+or-5)	20(+or-2.5)
3. At probe connector D145-A set decade resistance box to 203 ohm and at probe connector D146-A set decade resistance box to 203 ohm.	Not visible	145(+or-5)	0(+or-2.5)
NOTE: The yellow warning light on the front of the oil temperature indicator should come on at an inlet temperature of approx. 145 deg C. See operation 4., below.			
4. Vary the resistance box setting at probe connector D145-A and check that the yellow warning	Not visible	-	-

OPERATION	INDICATION SUPPLY FAILURE FLAG	INLET TEMP. (deg C)	DIFF. TEMP. (deg C)
light comes on at a setting within the range 200.5 to 205.5 ohm.			
5. At probe connector D145-A set decade resistance box to 230 ohm and at probe connector D146-A set decade resistance box to 249.1 ohm. Check that the yellow warning light remains on.	Not visible	200(+or-5)	40(+or-2.5)
6. At probe connector D145-A set decade resistance box to 130 ohm and at probe connector D146-A set decade resistance box to 130 ohm. Check that the yellow warning light is out.	Not visible	0(+or-5)	0(+or-5)

Oil Temperature Indication Circuits Resistance Settings
Table 501

D. Calibration - Nos.3 and 4 Oil Temperature Indication Circuits

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00.

(2) Test

(a) Trip the ENG 3 & 4 CSD OIL TEMP IND circuit breaker D141 on panel 15-216, map ref.C.25, and fit a safety clip.

(b) On the electrical generating control panel, observe Nos.3 and 4 CSD oil temperature indicators and check that each displays a red and black striped flag (power supply failure flag) at the aperture in the upper part of the dial.

(c) Open the engine bay doors as required to gain access to the CSD oil inlet and outlet temperature probes (bulbs) located at the bottom of No.3 IDG (Ref. 71-00-00). Disconnect -

c1) the electrical connector at the oil inlet temperature probe D145, and

c2) the electrical connector at the oil outlet temperature probe D146.

(d) Connect two decade resistance boxes, one between pins A and B of the oil inlet temperature probe 'free' connector D145-A and the other between pins A and B of the oil outlet temperature probe 'free' connector D146-A. Set each box at 130 ohm.

(e) Remove the safety clip and reset the ENG 3 & 4 CSD OIL TEMP IND circuit breaker D141 on panel 15-216, map ref.C25.

(f) Carry out the applicable operations detailed in Table 501 as applied to No.3 IDG oil inlet and outlet temperature probes and No.3 CSD oil temperature indicator.

(g) Trip the ENG 3 & 4 CSD OIL TEMP IND circuit breaker D141 on panel 15-216, map ref.C25.

(h) Disconnect and remove the decade resistance box from the 'free' connector D145-A and reconnect the connector to the oil inlet temperature probe D145, ensuring that the mating surfaces are clean and undamaged.

Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

(i) Disconnect and remove the decade resistance box from the 'free' connector D146-A and reconnect the connector to the oil outlet temperature probe D146, ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

(j) Open the engine bay doors as required to gain access to the CSD oil inlet and outlet temperature probes (bulbs) located at the bottom of No.4 IDG. Disconnect -

j1) the electrical connector at the oil inlet temperature probe D145, and

j2) the electrical connector at the oil outlet temperature probe D146.

(k) Connect two decade resistance boxes, one between pins A and B of the oil inlet temperature probe 'free' connector D145-A and the other between pins A and B of the oil outlet temperature probe 'free' connector D146-A. Set each box at 130 ohm.

(l) Remove the safety clip and reset the ENG 3 & 4 CSD OIL TEMP IND circuit breaker D141 on panel 15-216, map ref.C25.

(m) Carry out the applicable operations detailed in Table 501 as applied to No.4 IDG oil inlet and outlet temperature probes and No.4 CSD oil temperature indicator.

(n) Trip the ENG 3 & 4 CSD OIL TEMP IND circuit breaker D141 on panel 15-216, map ref.C25, and fit a safety clip.

(o) Repeat operations (h) and (i).

(p) Check that the power supply failure flag is fully visible at the dials of both Nos.3 and 4 oil temperature indicators.

(q) Remove the safety clip and reset the ENG 3 & 4 CSD OIL TEMP IND circuit breaker D141 on panel 15-216, map ref.C25, and fit a safety clip.

(r) Check that the power supply failure flag has disappeared at the dials of both Nos.3 and 4 oil temperature indicators.

(3) Conclusion

(a) Close the engine bay doors (Ref. 71-00-00).

(b) Switch off and disconnect electrical ground power as detailed in 24-41-00.

E. IDG Test and Adjustment

NOTE: The following test and adjustment procedure is applicable to the IDG in No.1 main generation channel. It is equally applicable to an IDG in any one of the other three main generation channels by substitution of the appropriate channel numeration in respect of the engine, IDG and associated controls and indicators.

The application of this test and adjustment procedure to an IDG is permitted only under single channel operating conditions, i.e., the IDGs in the other three main generation channels must not be run.

(1) Prepare

(a) Check the IDG oil level (Ref. 24-11-11, Inspection/Check).

(b) Ensure that the a.c. voltmeter and frequency meter on the electrical generating control panel indicate zero volts and frequency; then connect the precision-grade a.c. voltmeter and frequency meter to pins A and B of the a.c. test socket D116-A on panel 18-216.

(c) Make available electrical ground power as detailed in 24-41-00.

NOTE: The settings/indications of controls and indicators checked at the following operation (d) are those usual upon satisfactory connection of a ground power supply to the aircraft main a.c. distribution system (ground power breaker (GPB) closed).

(d) On the electrical generating control panel,

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ensure that -

d1) the A.C. FREQ/VOLTS selector switch is set to GRND PWR and the correct voltage and frequency are indicated on the a.c. voltmeter and frequency meter,

**ON A/C 007-007,

d2) the battery control switches are at OFF, the associated 'battery isolate' magnetic indicators display cross-line, and the essential/main split indicators display in-line.

**ON A/C 001-006,

d2) the battery control switches are at BATT OFF, the associated 'battery isolate' magnetic indicators display cross-line, and the essential/main split indicators display in-line,

d3) the SSB control switch is at CLOSE and the associated magnetic indicator displays in-line,

d4) Nos.1, 2, 3 and 4 BTB control switches are at NORM and the associated magnetic indicators display in-line,

d5) all four generator circuit breaker (GCB) magnetic indicators display cross-line,

d6) all four essential/main (NORM/EMERG) control switches are at NORM and the associated magnetic indicators display in-line,

d7) all four TRU control switches are at NORM, and

**ON A/C 007-007,

d8) only the captions GRND PWR AVAILABLE, CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and the ISOL sections of both BATT-FAIL/ISOL captions are illuminated.

**ON A/C 001-006,

d8) only the captions GRND PWR AVAILABLE, CSD 1,

CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and both BATT ISOLATE captions are illuminated.

(e) Set No.1 generator control switch to "OFF" and check that the associated magnetic indicator remains cross-line and that the caption GEN 1 remains illuminated.

(f) Check that the voltage and frequency of the ground power supply is indicated on the test voltmeter and frequency meter connected at the a.c. test socket.

(g) Set the A.C. FREQ/VOLTS selector switch to "GEN 1" and check that the voltage and frequency indications on the aircraft meters (i.e., those on the electrical generating control panel) and those on the test meters fall to near zero.

**ON A/C 007-007,

(h) In readiness for engine starting, set the battery control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

**ON A/C 001-006,

(h) In readiness for engine starting, set the battery control switches to "BATT ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(i) Ensure that the emergency generator mode switch is at AUTO.

(2) Test and Adjust IDG

CAUTION: IF A CSD (CONSTANT SPEED DRIVE) FAILURE CAPTION REMAINS ILLUMINATED AFTER THE ASSOCIATED ENGINE HAS RUN UP TO A SPEED OF 62 PER CENT N2 OR ABOVE, ABNORMAL OPERATION OF THE IDG IS INDICATED. THE CSD DISCONNECT SWITCH MUST THEN BE OPERATED TO THE "DISC" POSITION TO EFFECT DISENGAGEMENT OF THE IDG TRANSMISSION.

(a) Start and run No.1 engine at ground idle,

noting the procedures to be carried out if excessive CSD oil inlet temperature is indicated during the engine run (Ref. 71-00-00).
Check that the caption CSD 1 is extinguished and note the time at which the engine run commenced.

(b) Set and hold No.1 generator control switch at "TEST" and check that -

b1) No.1 GCB magnetic indicator remains cross-line,

b2) the caption GEN 1 remains illuminated,

b3) the correct voltage 115(+3 -5) V and the frequency, approximately 400 Hz, are indicated on the test meters, and

b4) the voltage and frequency indications on the aircraft meters are approximately the same as the indications on the test meters.

(c) Release No.1 generator control switch to "OFF" and check that the voltage and frequency indications on the aircraft meters and the test meters fall to near zero.

(d) Set No.1 generator control switch to "ON" and check that -

d1) No.1 GCB magnetic indicator changes from cross-line to in-line,

d2) the caption GEN 1 is extinguished, and

d3) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(e) Select, as necessary, such aircraft services as can be used to impose a total load greater than 40 kW but not exceeding 54 kW, as indicated on No.1 KW/KVAR meter. Check that -

e1) the correct voltage, 115(+3 -5) V, is indicated on the test voltmeter, and

e2) the frequency, approximately 400 Hz, is indicated on the test frequency meter.

NOTE: If the frequency indication is unstable or erratic, the IDG must be renewed.

(f) Check that the IDG oil temperature is indicated on the INLET and DIFF scales of No.1 CSD oil temperature indicator and that the overheat warning lamp on the front of the indicator is not lit.

NOTE: Under ground-running conditions, the oil inlet temperature and differential temperature will be generally of the order of 80 deg C and 15 deg C respectively. These values will vary according to the generator load and the ambient temperature.

(g) Check the time at which the engine run commenced and ensure that sufficient time has elapsed for the operation to stabilize.

NOTE: An engine running time of not less than 10 min is recommended to ensure that the IDG transmission output speed is stabilized to the degree necessary for the following test operations.

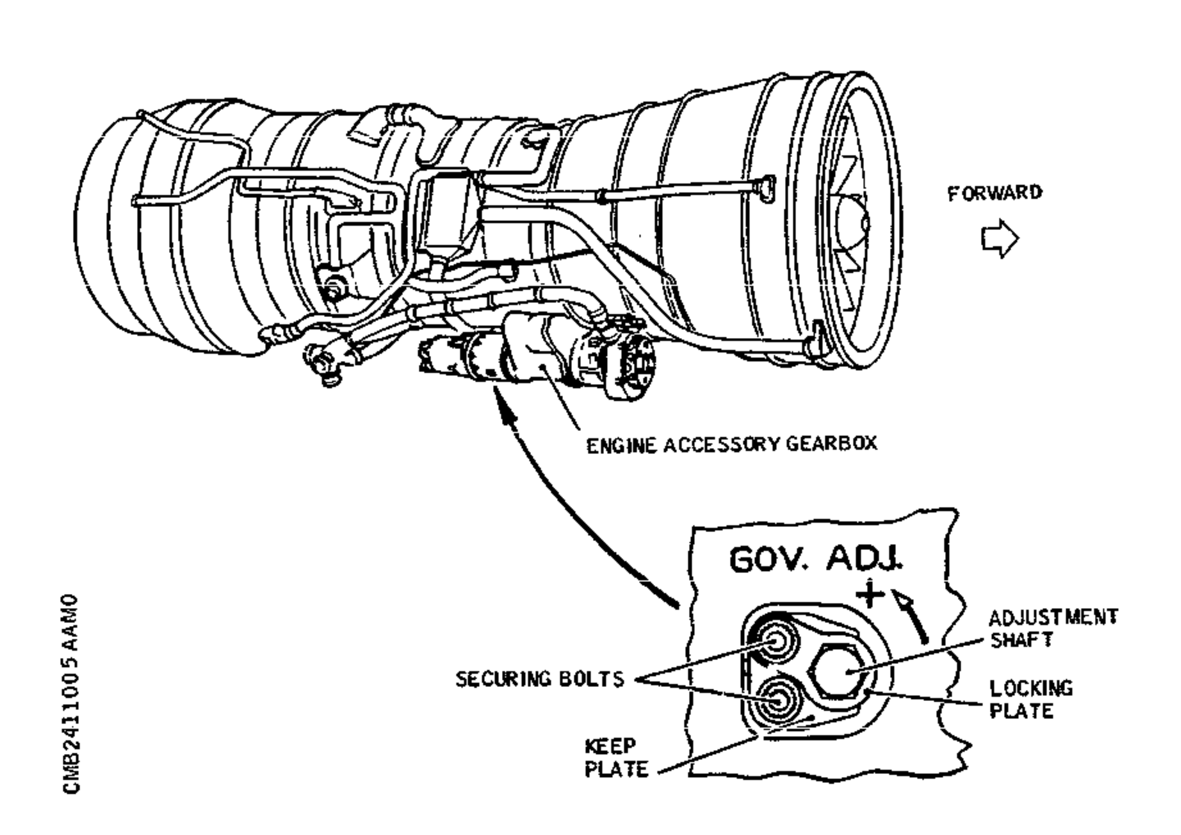
(h) Note precisely the frequency indication registered on the test frequency meter and check that the frequency is maintained at a level within the limits of 396 and 404 Hz. If the indicated level of frequency is outside the limits of 396 and 404 Hz, the IDG governor, which effects control of the IDG transmission output speed, must be adjusted. If the indicated level of frequency is within these limits, adjustment of the IDG governor is necessary only when difficulty has been experienced in bringing a generator into parallel operation.

NOTE: The need to adjust an IDG governor in order to resolve a difficulty in generator paralleling will have been determined, together with the operating frequency levels of all four main generators, by a previous test of the main a.c. generation system, at Functional Test level (Ref. 24-00-00) or at System Test level

(Ref. 24-21-00). Thus, if a frequency difference greater than 4 Hz has been registered between any two generators, the governor of the appropriate IDG must be adjusted to bring the operating frequency level of the generator to that of the average of the other three generators.

(i) If adjustment of the IDG governor is required, proceed at operation (j). If adjustment of the governor is not required, proceed at operation (k).

(j) Adjust the IDG governor (Ref. Fig. 501) as follows:-



IDG Governor Adjustment
Figure 501

WARNING: IDG GOVERNOR ADJUSTMENT MUST NOT BE ATTEMPTED WHILE THE ASSOCIATED ENGINE IS RUNNING.

j1) Record the level of frequency registered on the test frequency meter.

j2) Shut down No.1 engine (Ref. 71-00-00).

j3) Place a suitable placard in the flight compartment to warn that personnel are working in the engine bay; then open the engine bay doors as required to gain access to the IDG (Ref. 71-00-00).

j4) Raise and swing the locking plate clear of the governor adjustment shaft by unscrewing the locking plate securing bolt to the necessary extent.

NOTE: Rotation of the adjustment shaft through two complete turns effects a change of approximately 1 Hz.

j5) Turn the adjustment shaft counter-clockwise to raise the frequency, clockwise to lower the frequency. Adjust as necessary to obtain a frequency level of 400(+or-2) Hz. If required to resolve a difficulty in generator paralleling, adjust as necessary to obtain a frequency level within the limits of 396 and 404 Hz in accordance with the directions given in the NOTE under operation (h).

j6) Refit the locking plate to the governor adjustment shaft and secure it with the bolt, checking that the run-down torque of the bolt in its Screwlock insert is not less than 2.1 lbf in (0.024 mdaN). If the insert does not meet this requirement, remove the plate and fit a new Screwlock insert (Ref. Approved Repairs). Finally, torque-tighten the locking plate securing bolt to between 38 and 42 lbf in (0.430 and 0.475 mdaN).

NOTE: If, for any reason, release and retightening of the other (keep plate) securing bolt is necessary, the run-down torque of the bolt must be checked as detailed above, and the bolt must be finally torque-tightened to between 38 and 42 lbf in (0.430 and 0.475 mdaN).

j7) Ensure that all personnel are safely located and that the aircraft is safe for No.1 engine to be restarted (Ref. 71-00-00); then remove the warning placard from the flight compartment.

j8) Restart and run No.1 engine at ground idle (Ref. 71-00-00). Check that the caption CSD 1 is extinguished. Check also that -

No.1 generator control switch is set to ON,

No.1 GCB magnetic indicator changes from cross-line to in-line,

the caption GEN 1 is extinguished,

Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line, and

the generator loading requirements are met as defined in operation (e).

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

j9) Allow sufficient time for the IDG transmission to stabilize.

j10) Note precisely the frequency indicated on the test frequency meter. Check that the frequency is maintained at a level within the limits of 396 and 404 Hz and, if an adjustment has been made to meet a generator paralleling requirement, that the registered frequency level is acceptable.

j11) If required, carry out a System Test to check that generator paralleling is satisfactory as detailed in 24-21-00.

j12) If the level of frequency registered on the test frequency meter is satisfactory, proceed at operation (k). If further adjustment is required repeat all the preceding operations j1) to j11) inclusive.

NOTE: If frequent adjustment of an IDG governor is found necessary, the IDG must be renewed.

(k) Remove the aircraft loads from No.1 generator by holding No.1 generator control switch at "TEST" and note the frequency indicated on the test frequency meter. Check that the frequency is maintained at a level within the limits of 396 and 404 Hz. If the frequency indication is unstable or erratic or deviates from these limits, the IDG must be renewed.

(l) Re-impose the aircraft loads on No.1 generator by setting No.1 generator control switch to "ON", checking that -

l1) No.1 GCB magnetic indicator changes from cross-line to in-line,

l2) the caption GEN 1 is extinguished,

l3) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line, and

l4) the frequency indicated on the test frequency meter is maintained at a level within the limits of 396 and 404 Hz. If the frequency indication is unstable or erratic or deviates from these limits, the IDG must be renewed.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(m) Set No.1 generator control switch to "OFF" and check that -

m1) No.1 GCB magnetic indicator changes from in-line to cross-line,

m2) the caption GEN 1 is illuminated,

m3) the voltage and frequency indications on the aircraft meters and the test meters fall to near zero,

m4) the GPB closes, by observing that Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2,

3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

CAUTION: DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

(n) Set the CSD disconnect switch to "DISC" and then release to "NORM". Check that the caption CSD 1 is illuminated, indicating, by loss of charge oil pressure, that the IDG is disconnected.

(o) Set No.1 generator control switch to "TEST" and check that the voltage and frequency indications on the aircraft meters and the test meters fall to near zero; then set the switch to "ON".

(p) Shut down No.1 engine (Ref. 71-00-00).

**ON A/C 007=007,

(q) Sett BATT A and BATT B control switches to "OFF".

**ON A/C 001-006,

(q) Set BATT A and BATT B control switches to "BATT OFF".

(3) Conclusion

(a) Ensure that the voltage and frequency indications on the aircraft meters and the test meters are at zero; then disconnect the test voltmeter and frequency meter from the d.c. test socket.

(b) Set the A.C. FREQ/VOLTS selector switch to "GRND PWR".

(c) Reset the IDG (Ref. para.3.).

3. IDG Resetting After Disconnection

A. Prepare

(1) Make available electrical ground power as detailed

in 24-41-00.

(2) Place a suitable placard in the flight compartment to warn that personnel are working in the engine bay; then gain access to the IDG. Open the engine bay doors as required (Ref. 71-00-00).

B. Reset IDG

WARNING: THE IDG DISCONNECT RESET HANDLE MUST NOT BE OPERATED UNTIL ROTATION OF THE ASSOCIATED ENGINE HAS CEASED.

(1) Pull the IDG disconnect reset handle as required to reset the disconnect mechanism.

NOTE: The IDG disconnect reset handle is located at the bottom of the IDG and labelled RESET WITH ENGINE STATIC. The reset handle is connected to a disconnect plunger, which is spring-loaded and normally held retracted by engagement of the nose pin of the disconnect solenoid. When the disconnect solenoid is energized, the disconnect plunger is released and engages the disconnect mechanism so that the IDG is disconnected from the input (drive) shaft. The reset handle enables the disconnect plunger to be withdrawn to the position at which it is engaged by the solenoid nose pin.

(2) Carry out an inspection/check of the IDG (Ref. 24-11-11, Inspection/Check).

(3) Ensure that all personnel are safely located and that the aircraft is safe for the associated engine to be restarted (Ref. 71-00-00); then remove the warning placard from the flight compartment.

**ON A/C 007-007,

(4) On the electrical generating control panel, set BATT A and BATT B control switches to "ON".

**ON A/C 001-006,

(4) On the electrical generating control panel, set BATT A and BATT B control switches to "BATT ON".

(5) On the electrical generating control panel, check

that the associated CSD warning caption is illuminated.

(6) Start and run the associated engine at ground idle (Ref. 71-00-00). Check that the associated CSD warning caption is extinguished.

(7) Shut down the associated engine (Ref. 71-00-00) and check that the associated CSD warning caption is illuminated.

C. Conclusion

**ON A/C 007-007,

(1) Set BATT A and BATT B control switches to "OFF".

**ON A/C 001-006,

(1) Set BATT A and BATT B control switches to "BATT OFF".

(2) Check the IDG oil level (Ref. Inspection/Check).

(3) Close the engine bay doors (Ref. 71-00-00).

(4) Switch off and disconnect electrical ground power as detailed in 24-41-00.

INTEGRATED DRIVE GENERATOR - DESCRIPTION AND OPERATION

1. General

An integrated drive generator (IDG) consists of an axial gear differential transmission coupled to a direct spray cooled a.c. generator. The generator is nominally rated at 60 kVA and is used to provide 200/115 V three-phase 400 Hz a.c. power for the aircraft main a.c. generation system (Ref. 24-11-00).

The function of the transmission is to convert the variable speed of the engine to a constant speed so that the a.c. generator it drives produces a current at a frequency of 400 Hz within very close limits. It incorporates a hydraulic system with mechanical controls governing the output speed, the precise frequency control required for generator paralleling being provided by a magnetic trimming device.

The term 'constant speed drive' (CSD) is used to identify the transmission component of an IDG, and the abbreviation CSD is used for the identification of associated control and indication equipment in the aircraft.

When the engine speed is lower than that needed to produce the required generator speed, the hydraulic system adds speed to the differential gearing. When the hydraulic system is adding speed the CSD is operating in overdrive.

When the engine speed is sufficient to produce the required generator speed, the transmission acts merely as a mechanical coupling, neither adding nor subtracting speed, and the CSD is operating in straight-through drive.

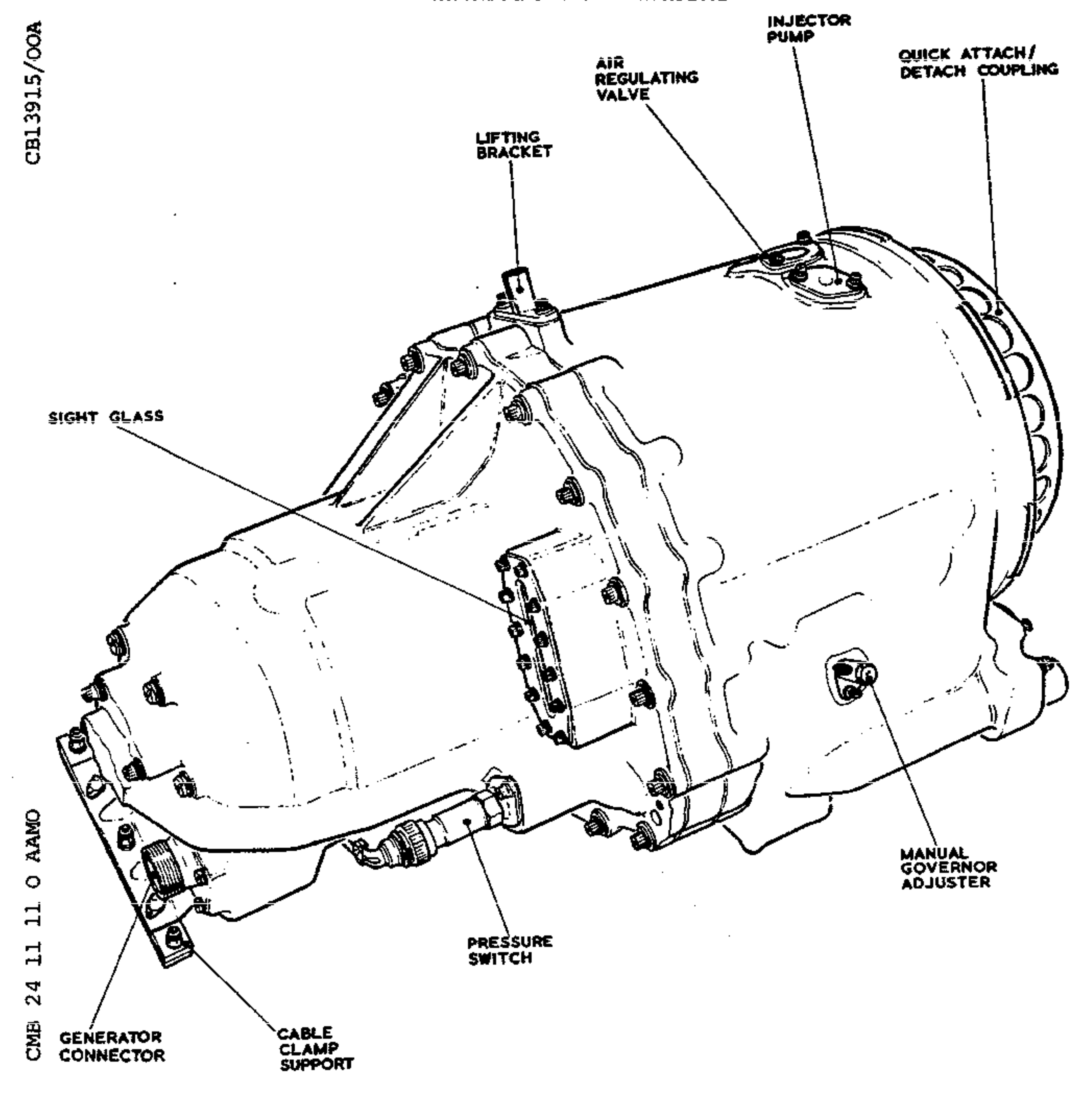
When the engine speed is greater than that needed to produce the required generator speed, the hydraulic system subtracts speed from the differential gearing. The CSD thus operates in an underdrive condition.

2. Construction (Ref. Fig.001 and 002)

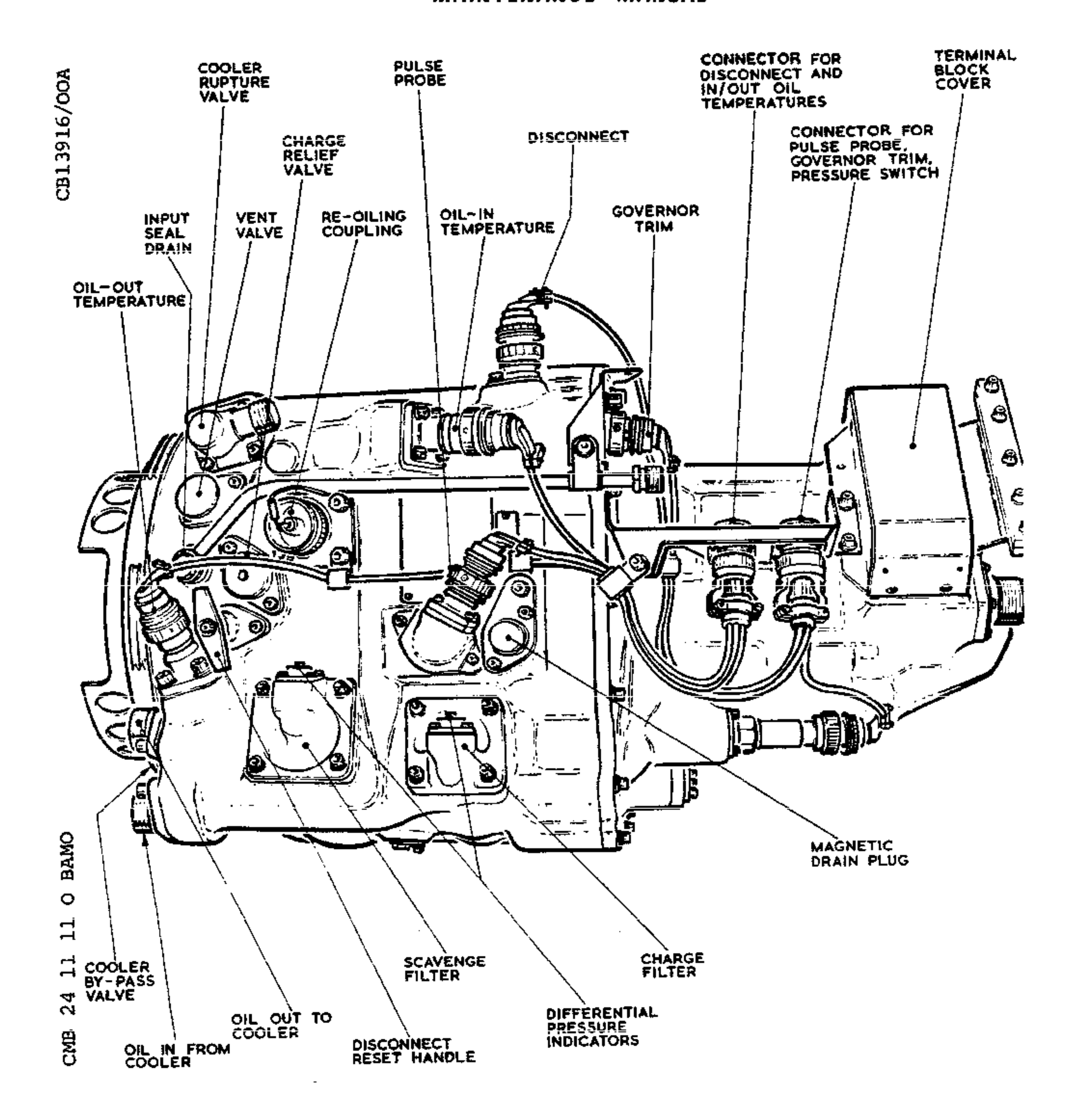
An IDG is assembled and tested as a unit.

The CSD transmission and auxiliary elements are housed in a magnesium alloy casing which is secured to the aircraft engine accessory gearbox flange by means of a quick-attach/detach (QAD) coupling. The CSD transmission and auxiliary elements are described in paragraph 3.

The a.c. generator is mounted on the end of the transmission assembly which also supports the drive end of the generator



IDG - Side View
Figure 001



IDG - Underside View
Figure 002

shaft. The generator is separately described in paragraph 5.

3. CSD Transmission (Ref. Fig. 003)

A. Differential Assembly

The differential assembly is essentially a summing device controlled through fixed and variable hydraulic units of a twin pump and motor assembly, via a differential bell gear. The required output speed is achieved by the differential assembly adding to or subtracting from the input speed. It contains a pinion carrier body on which are mounted two pinions in mesh with each other and one in mesh with the output gear and bell gear.

The pinion carrier body is driven by the transmission input shaft, a gear integral with the pinion carrier body driving the twin pump and motor assemblies at the variable input speed.

The outer gear of the bell gear is driven by the fixed hydraulic units in either direction depending upon the input speed to the transmission. The output gear is connected, via a sprag clutch, to an inner clutch shaft carrying the generator input shaft. The sprag clutch allows the generator to overrun the output gear under transient conditions.

B. Pump and Motor Assembly (Ref. Fig. 004)

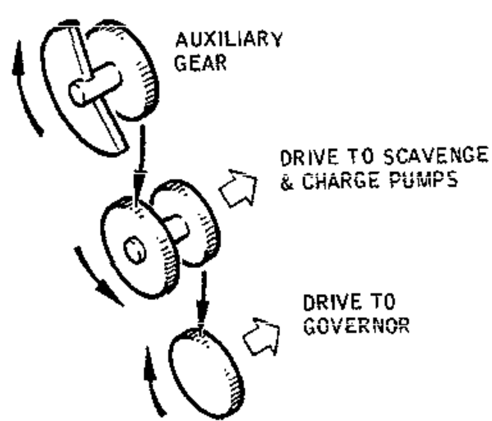
The pump and motor assembly comprises twin, mechanically coupled, fixed and variable hydraulic units. The wobbler plates of the variable hydraulic units are coupled to a common control cylinder.

Each variable hydraulic unit comprises a cylinder block, reciprocating pistons and a variable angle wobbler plate. The variable units are geared directly to the aircraft engine so the speed of the cylinder blocks is always proportional to the input speed and the direction of rotation is always the same. The variable-angle wobblers are adjusted by governor action through the control cylinder to regulate the displacement of oil pumped by the pistons through the port plate to the fixed hydraulic units.

Each fixed hydraulic unit comprises a cylinder block, reciprocating pistons and fixed angle wobbler plate. The units are geared directly to the differential bell gear and their speed is determined by the displacement of high pressure oil delivered by the variable hydraulic units.

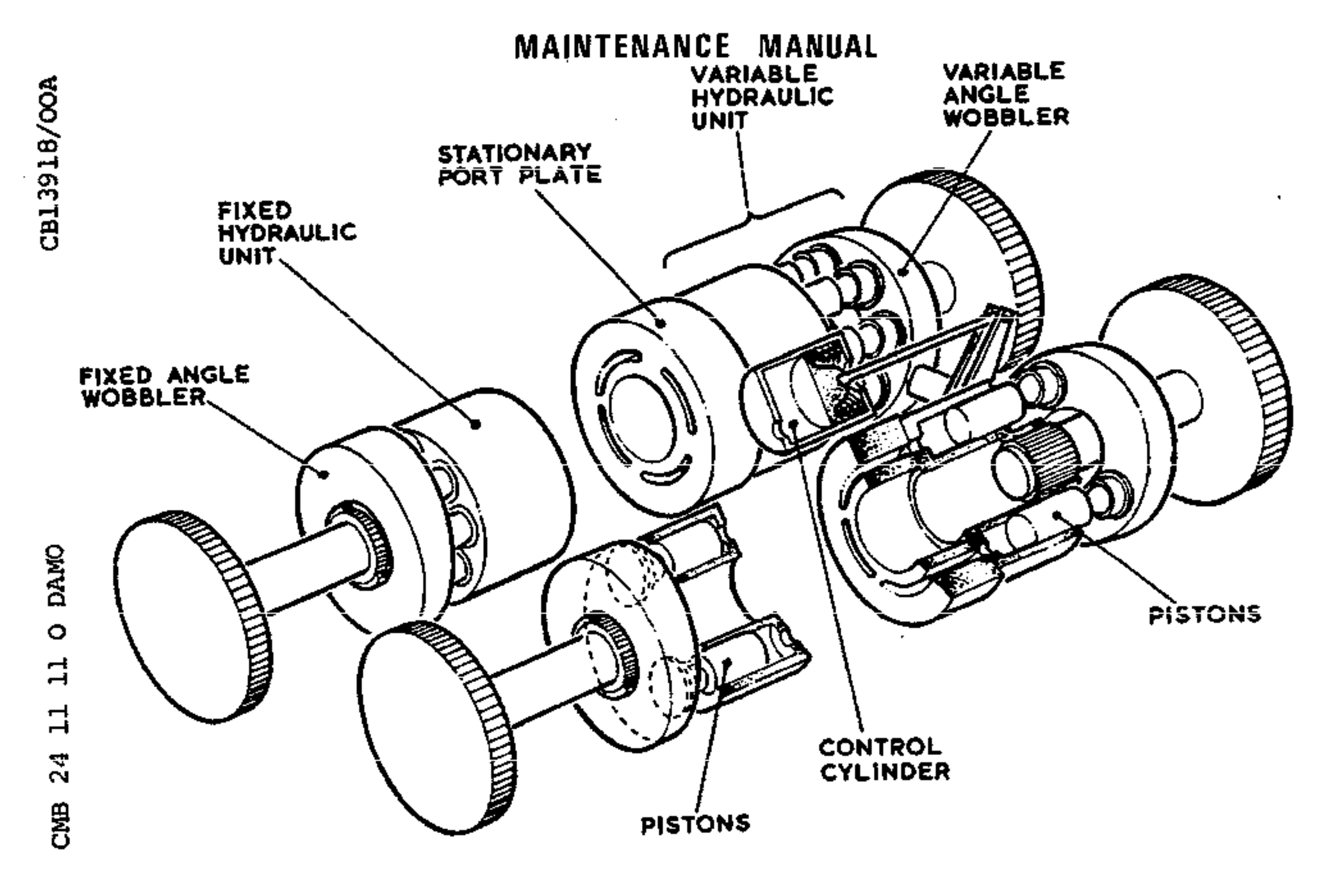
CB13917/00A

VARIABLE HYDRAULIC UNIT
CONTROL CYLINDER
PORT PLATE
FIXED HYDRAULIC UNIT
PUMP & MOTOR ASSEMBLY
IDG INPUT
PINIONS
BELL GEAR
PINION CARRIER BODY
OUTPUT GEAR
DIFFERENTIAL ASSEMBLY
INNER CLUTCH SHAFT
SPRAG CLUTCH



CMB 24 11 11 0 CAMO

CSD Transmission
Figure 003



Pump and Motor Assembly
Figure 004

The direction of rotation of the fixed hydraulic units is dependent on the positive (i.e., overdrive) or negative (i.e., underdrive) setting of the variable wobbler angle.

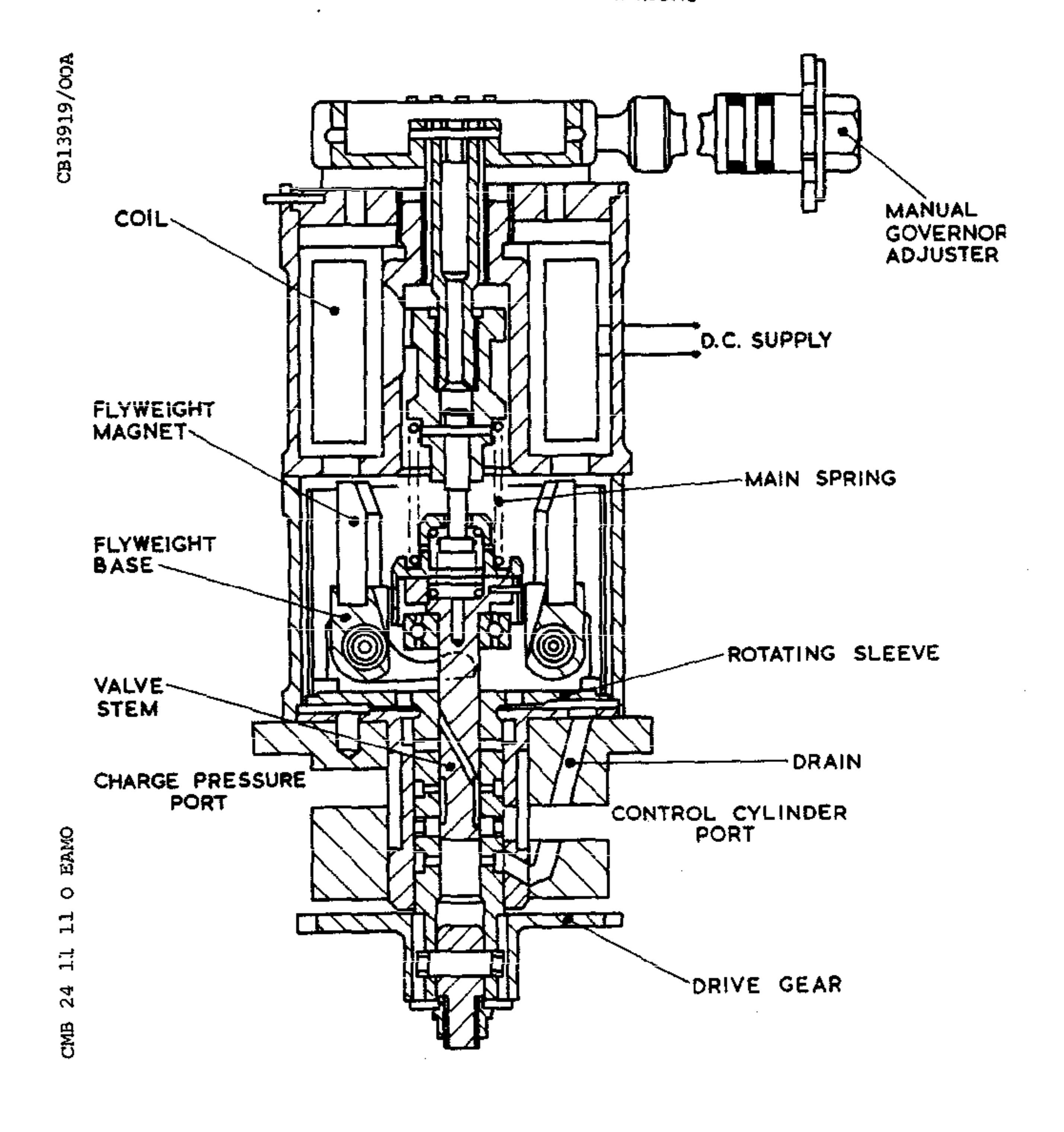
C. Control cylinder (Ref. Fig. 004)

The variable wobbler angles are adjusted by governor action through the control cylinder, which is a double-acting biased control piston, connected to the two variable wobbler plates by an interconnected linkage assembly. One side of the piston is subjected to regulated charge pump pressure from the governor and the other side is subjected to unregulated charge pressure.

D. Governor (Ref. Fig. 005)

The governor is a spring-biased, flyweight-operated unit, geared directly to the output shaft to sense and control the output speed by ducting oil to and from the control cylinder to adjust the variable wobbler angle as required.

The governor incorporates an electromagnetic trimming



Governor
Figure 005

device which provides fine adjustment of the spring-biased flyweight unit for more precise frequency control when the associated generator is operating in parallel with one or more of the other generators.

E. Disconnect Mechanism (Ref. Fig. 006)

A spring-loaded spline shaft and disconnect shaft are located in the input end of the pinion carrier body of the transmission. The input shaft is driven directly from the engine accessory gearbox and the drive between the spline shaft and input shaft is made by a dog-tooth type clutch.

A disconnect solenoid and plunger enable the transmission to be disconnected from the input shaft in the event of malfunction, by effecting separation of the driving dogs of the clutch on the spline shaft and input shaft.

F. Hydraulic System (Ref. Fig. 007)

The main components of the hydraulic system are a charge pump, a scavenge pump and a charge relief valve.

The charge pump is situated in the hydraulic circuit between an all-attitude reservoir and the transmission. It is driven by the output shaft and supplies oil via the charge filter to the a.c. generator, cylinder blocks, control cylinder and governor.

Two scavenge pumps are fitted. One pump scavenges the transmission at the drive end of the generator; a second pump scavenges the tail end of the generator. The pumps are driven by the output shaft and have greater capacity than the charge pump, to ensure dry sump conditions.

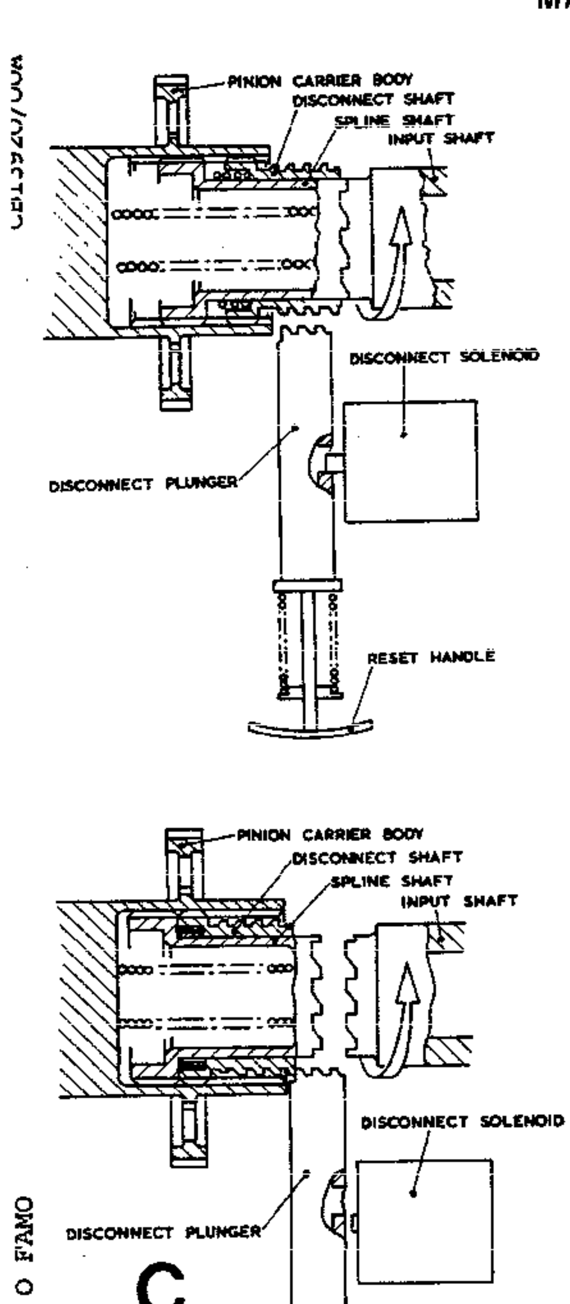
The charge relief valve controls the operating pressure of the charge oil system.

Cooling is effected by the routing of the IDG oil, via external piping, through a section of the fuel-cooled engine oil cooler which is mounted on the left-hand side of the engine (Ref. 79-00-00). All other components of the IDG oil system are contained within the IDG casing.

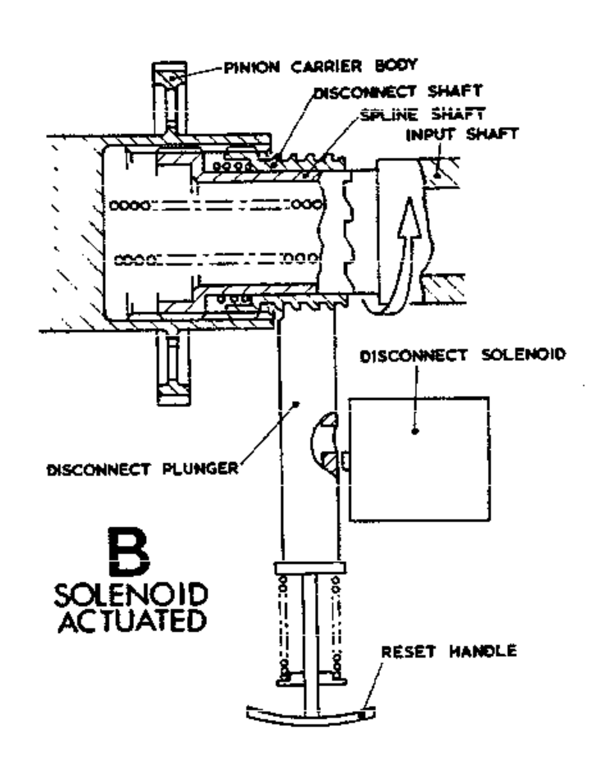
An oil level sight glass is fitted in the generator part of the IDG casing.

4. Auxiliary Elements

A. Charge Oil Filter

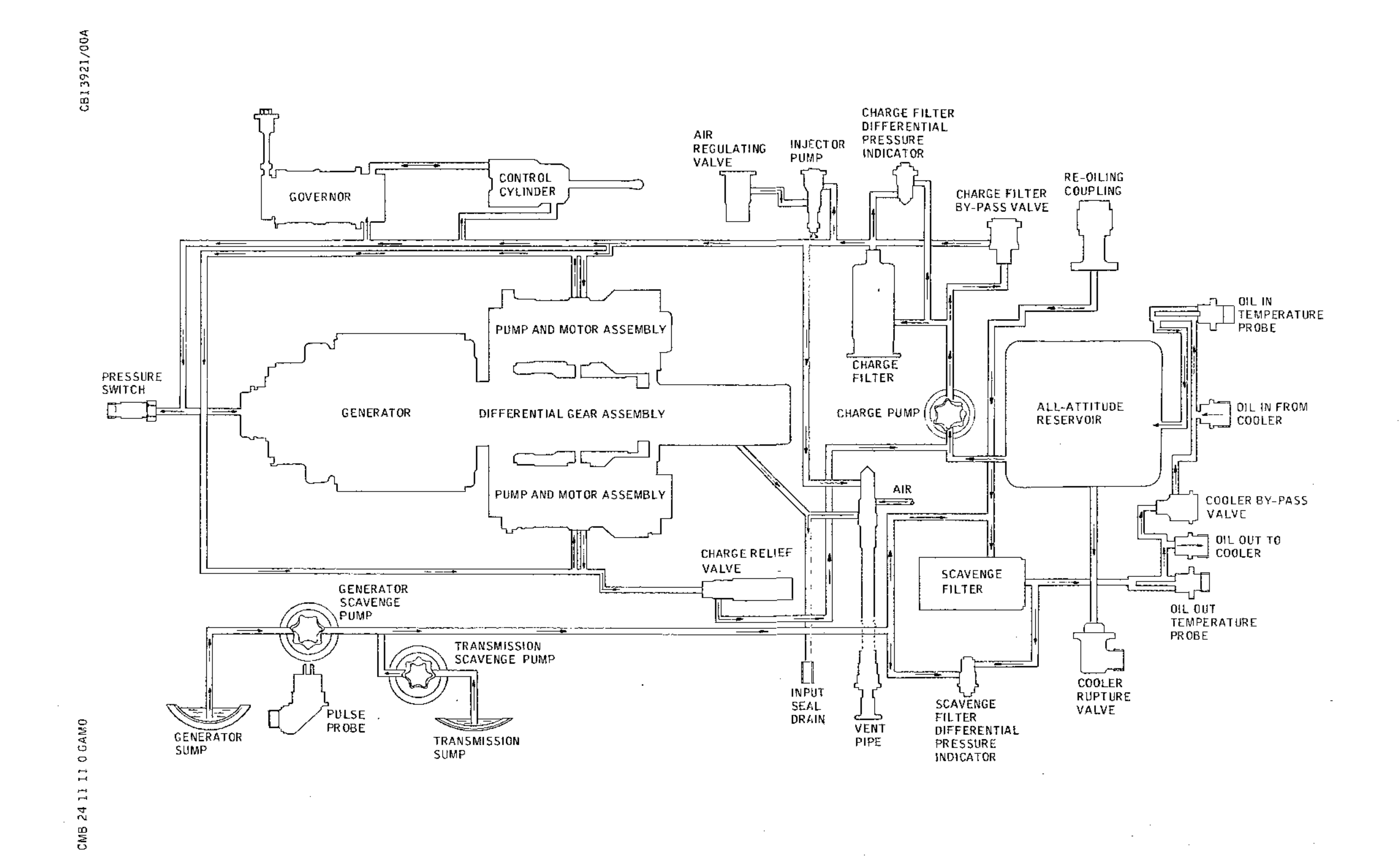






Disconnect Mechanism
Figure 006

INTENTIONALLY BLANK



R - Oil Circuit - Schematic Diagram
Figure 007

A charge oil filter is positioned in the oil system immediately downstream from the charge pump. It removes any foreign matter from the oil before it passes to the transmission. The filter is equipped with an internal bypass valve which permits a flow of oil around the filter in the event of clogging.

B. Scavenge Filter

A scavenge filter is positioned between the scavenge pumps and the oil outlet from the transmission to the oil cooler. Oil supplied to the IDG through the re-oiling coupling passes through the filter before reaching the all-attitude reservoir via the oil cooler.

C. Filter Differential Pressure Indicators

Differential pressure indicators are fitted, one in the cap of the charge oil filter and one in the cap of the scavenge filter to give visual indication of filter condition. Indication is given by a red button that protrudes when the filter element requires renewal.

D. Pulse Probe

In order to ascertain the output speed of the CSD for generator control and protection purposes, an inductance-type probe is fitted and a signal is obtained by measuring pulses from an output driven gear in the CSD transmission.

E. Injector Pump and Air Regulating Valve

Excess charge oil passes through an injector pump venturi to pressurize the IDG casing. The air regulating valve connected to the injector pump maintains the pressurization at a constant positive cae pressure. A case pressure vent valve is fitted to the IDG casing to enable air pressure to be relieved during IDG servicing.

F. Pressure Switch

A pressure switch is fitted into the oil charge line. It is connected to an external warning light to give an indication if low charge pressure occurs, which could be a symptom of CSD malfunction.

G. Oil Temperature Probes (Bulbs)

Oil inlet and outlet temperatures are measured by associated temperature bulbs, and provide oil temperature information for presentation on an external indicator.

H. All-attitude Oil Reservoir

The all-attitude oil reservoir is integral with the IDG casing and embodies a centrifugal de-aerator and a plenum chamber which always remains full, giving complete all-attitude capacity.

A cooler rupture valve is fitted to the oil reservoir to prevent IDG pressurization in the event of a ruptured cooler allowing the ingress of high pressure fuel into the IDG. If a rupture should occur, the valve will relieve excess pressure by dumping the fuel/oil mixture to an overboard drain.

I. Oil Cooler Bypass Valve

This valve is connected across the oil inlet and outlet in the connection block on the IDG casing. It protects the aircraft cooler from damage due to high pressure during a CSD cold start.

The cooler bypass valve is set to open at 100 psi (6.895 bar) approximately.

J. Magnetic Drain Plug

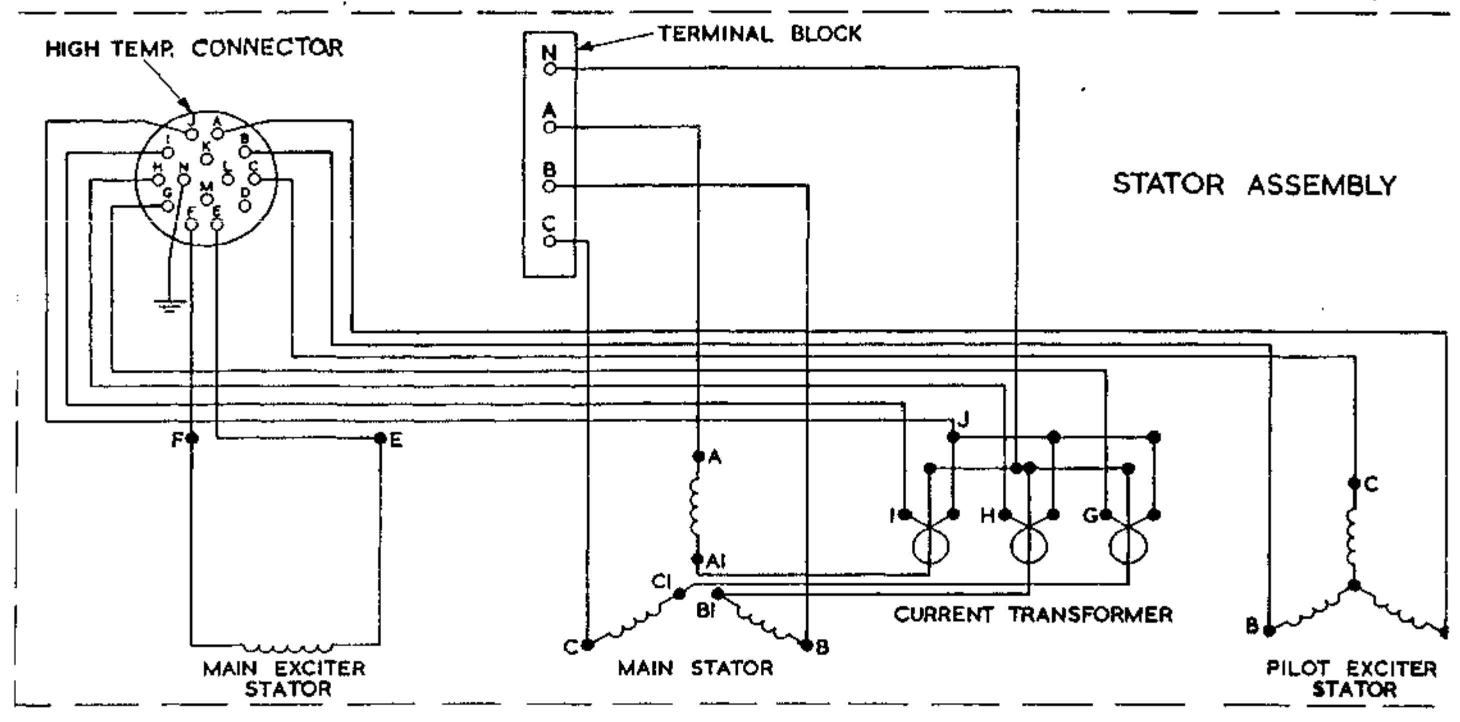
A bayonet-fitting magnetic drain plug (magnetic probe) is located at the bottom of the IDG. It fits into a self-sealing valve body enabling the probe to be inspected for evidence of contamination, without loss of oil. Drainage is effected by use of a drain adapter to open the self-sealing valve.

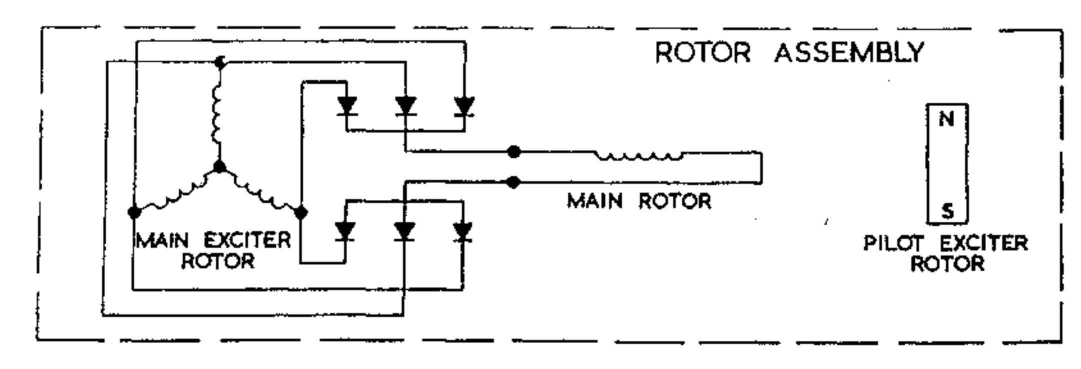
5. Generator (Ref. Fig. 008)

The a.c. generator is an oil-cooled brushless machine incorporating within a common frame, a permanent magnet pilot exciter, the main exciter, a rotating silicon rectifier assembly, and a three-phase main generator rated at 60 kVA (0.75 Power Factor). The main generator stator windings are star-connected internally; the star point is brought out to the terminal assembly. The output voltage is 200 V line-to-line (115 V line-to-neutral) at a frequency of 400 Hz when driven at 12,000 rpm.

The pilot exciter is a permanent magnet generator which provides excitation power under all load and fault conditions, and also the power required for the control and protection functions of the associated system.

Current transformers, mounted in the terminal housing,





Generator - Schematic Diagram
Figure 008

form part of the differential current protection circuit of the control and protection unit (CPU) in the associated main a.c. generation channel (Ref. 24-21-00). Auxiliary electrical connections are made through a connector receptacle and main supply connections via a terminal block mounted on the generator casing.

Lubrication and cooling oil is supplied by the charge pump of the CSD to the generator inlet port, through the generator frame into the hollow rotor shaft, where the oil is divided into different parallel paths. After lubricating the tail-end bearing and the drive splines, the oil is centrifuged through the rotor windings and provides cooling for the three stator windings. From the windings the oil drains back to the CSD.

6. Operation (Ref. Fig. 003, 004 and 005)
(Ref. Fig. 006, 007 and 008)

A. CSD

(1) Overdrive

At a low input speed the flyweight governor ports supply oil to the control cylinder, forcing the control piston back against its spring to move the variable wobblers to a large positive angle, through the control linkage, so that a large volume of oil is displaced by movement of the pistons in the rotating variable hydraulic units cylinder blocks.

The variable hydraulic units, functioning as oil pumps at this stage, feed the displaced oil at high pressure to the fixed hydraulic units to rotate the cylinder blocks, the gears of which act on the outer gear of the differential bell gear. The fixed hydraulic units, functioning as motors, rotate the bell gear in the opposite direction to the differential pinion carrier body to add speed to the output gear. The CSD is thus operating in the overdrive condition.

(2) Straight-through Drive

As the input speed increases the governor feeds less oil to the control cylinder and the variable wobbler angles decrease. A smaller volume of oil is now displaced by piston movement in the variable hydraulic units and less oil is fed to the fixed hydraulic units, causing the cylinder blocks to rotate at a lower speed, thereby reducing the speed of the bell

gear sufficiently to maintain the output gear speed constant.

This process continues until the variable wobbler angles are such that no oil is received or pumped by the variable hydraulic unit, the fixed hydraulic units cylinder blocks stop rotating and the bell gear is held stationary. The CSD is thus operating in a straight-through drive condition.

(3) Underdrive

If the input speed continues to increase, the governor supplies more oil from the control cylinder and the variable wobblers are moved to a negative angle. This allows oil to flow from the fixed hydraulic units to the variable units.

Under the influence of the reaction torque on the bell gear, the fixed hydraulic uhits are driven in the same direction as the variable units. Hence, the bell gear rotates in the same direction as the pinion carrier body and subtracts speed from the output gear. The CSD is thus operating in an underdrive condition.

(4) Magnetic Trim

Trimming of the flyweight governor is effected by a coil in the magnetic trim head. When the generator is operating in parallel with one or more generators, the coil is energized by a d.c. supply from the associated load controller, the supply being regulated in response to load comparison signals from paralleled generators. Thus, depending on the direction of the d.c. supply, the flyweights are attracted or repelled to reduce or increase the oil supplied to the control cylinder, so slightly increasing or decreasing the output speed as required. When the generator is operating in the non-paralleled mode, the trim head coil is not energized, but a d.c. supply can be applied via the load controller, by operation of an external push-switch. This enables the generator speed to be momentarily increased to assist generator paralleling.

(5) Disconnect

When the disconnect solenoid is actuated, the spring-loaded disconnect plunger moves into engagement with the buttress thread of a disconnect shaft. With the plunger acting as a partial nut and the disconnect

shaft as a screw, input rotation causes the disconnect shaft to move away from the input shaft. This action forces the spline shaft against its spring away from the input shaft, thus separating the driving dogs. The engine-driven input shaft is then free to rotate without driving the transmission. The disconnect mechanism can only be reset by manually pulling the disconnect reset handle at the bottom of the IDG, with the engine stopped, until the solenoid nose pin re-engages in the disconnect plunger.

(6) Oil Circuit

Oil is drawn from the all-attitude reservoir by the charge pump and passed through the charge oil filter which removes any foreign matter. The associated bypass valve permits oil to detour around the filter in the event of a choked element. Oil leaving the filter is ducted to the transmission control cylinder, governor and hydraulic units cylinder blocks, and to the generator for lubrication and cooling.

Charge oil returning from the cylinder blocks is passed through the charge relief valve and the spill therefrom is returned to the input side of the charge pump.

The aerated drain oil which collects in the transmission and generator sumps is pumped by the two scavenge pumps, through the scavenge filter, to the oil cooler. Return oil from the oil cooler passes directly to the all-attitude reservoir.

Lubrication of the transmission bearings and gears is effected by the direct ducting of oil to components of the differential assembly and by the oil mist which exists in the transmission during operation. The input shaft splines are lubricated by oil from the engine gearbox. Double sealing is provided between the input shaft and engine gearbox, with a seal drain at the interspace enabling any leakage to be ducted overboard.

B. Generator

(1) Generation

When the generator is driven, the rotating field of the permanent magnet develops a voltage in the pilot exciter (PE) stator. The output from the PE stator is fed into the associated CPU which rectifies and

regulates the flow of excitation current to the main exciter field windings. The main exciter stator energizes the main exciter rotor which, through the three-phase full-wave bridge, supplies the field system of the main generator. The three-phase stator windings of the main generator provide the nominal line-to-line output of 200 V, 400 Hz at 12,000 rpm.

(2) Current Protection

The outputs of the current transformers in the terminal housing are fed to the associated CPU and are used for differential feeder current protection of the system.

(3) Lubrication and Cooling

Lubricating and cooling oil is circulated through the generator by the charge pump of the CSD. The oil enters the mounting face of the generator, passes through the frame into the hollow shaft of the rotor where the oil is divided into five parallel paths. The first path provides oil to lubricate the tail end bearing. The second and third paths provide oil to cool the main rotor windings, diodes and main exciter windings. Oil from these three paths is centrifuged off the rotor to cool the three stator windings. From the windings, the oil drains back to the sump in the CSD for filtering and recirculation. A fourth path provides oil to lubricate the generator drive-shaft splines; a fifth path provides local lubrication for the transmission.

INTEGRATED DRIVE GENERATOR - SERVICING

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

An integrated drive generator (IDG) is mounted on an accessory gearbox on the right-hand side of each engine.

CAUTION: IF CONTAMINATION OF THE IDG OIL SYSTEM IS SUSPECTED THE CONNECTING PIPES MUST BE FLUSHED WITH WHITE SPIRIT AND DRIED THOROUGHLY AND THE OIL COOLER MUST BE FLUSHED (REF. CHAP. 79).

The following procedures are detailed under separate paragraphs as follows:

IDG Oil System - Filling and Priming (Ref. para.2.)
IDG Oil System - Draining (Ref. para.3.)
IDG Oil System - Flushing (Ref. para.4.)

2. IDG Oil System - Filling and Priming (Ref. Fig. 301)

CAUTION: SERIOUS DAMAGE TO THE IDG WILL RESULT IF IT IS STARTED WITHOUT OBSERVING THE PRIMING INSTRUCTIONS OR IF THE OIL LEVEL IS LOW.

IF THE IDG WAS LAST RUN WITH OIL OF A TYPE DIFFERENT FROM THAT TO BE USED FOR REFILLING, THE IDG MUST BE FLUSHED (REF. PARA. 4.).

OIL REMOVED FROM AN IDG MUST NOT BE USED FOR FILLING OR REPLENISHMENT.

A. Equipment and Materials

DESCRIPTION	PART NO.
Replenishing gun	Risbridger Type 786
Adapter, for connection of the replenishing gun delivery hose to the IDG re-oiling coupling. This adapter, together with the conical filter supplied as part of the gun assembly, must be fitted in place of the coupling supplied as part of the gun assembly	H.T.E. 8104001 (H.T.E. Ltd.)
NOTE: The replenishing gun is designed for use with a standard U.S. quart can of approved oil and incorporates a combined suction pipe and can opener.	
Drain hose, for draining oil from the IDG to adjust oil level. (Fitted in place of the magnetic drain plug, this lifts an internal self-closing valve)	OL-VDB 3315 (Vatric)
Appproved IDG operating oil to Spec.MIL-L-23699B:	
R Esso oil (Esso Oil Co.)	ETO 2380 (Pre Mod 2246 or 2284)
R Approved IDG operating oil to Spec.D.Eng. R RD2497 and Spec.MIL.L23699B:	
R Esso oil R (Esso Oil Co.) R	ETO 25 ETO 2380 (Post Mod 2246)
Approved IDG Operating oil to Spec.D.Eng. RD 2497:	
Esso Oil (Esso Oil Co.)	ETO 25 (Post Mod 2284)

B. Prepare

CAUTION: ENSURE THAT ALL PARTS OF THE REPLENISHING GUN, INCLUDING THE DISPOSABLE FILTER IN THE BODY OF THE GUN, ARE CLEAN AND FREE FROM CONTAMINATION BY OIL OF A SPECIFICATION DIFFERENT FROM THAT APPROVED FOR THE IDG.

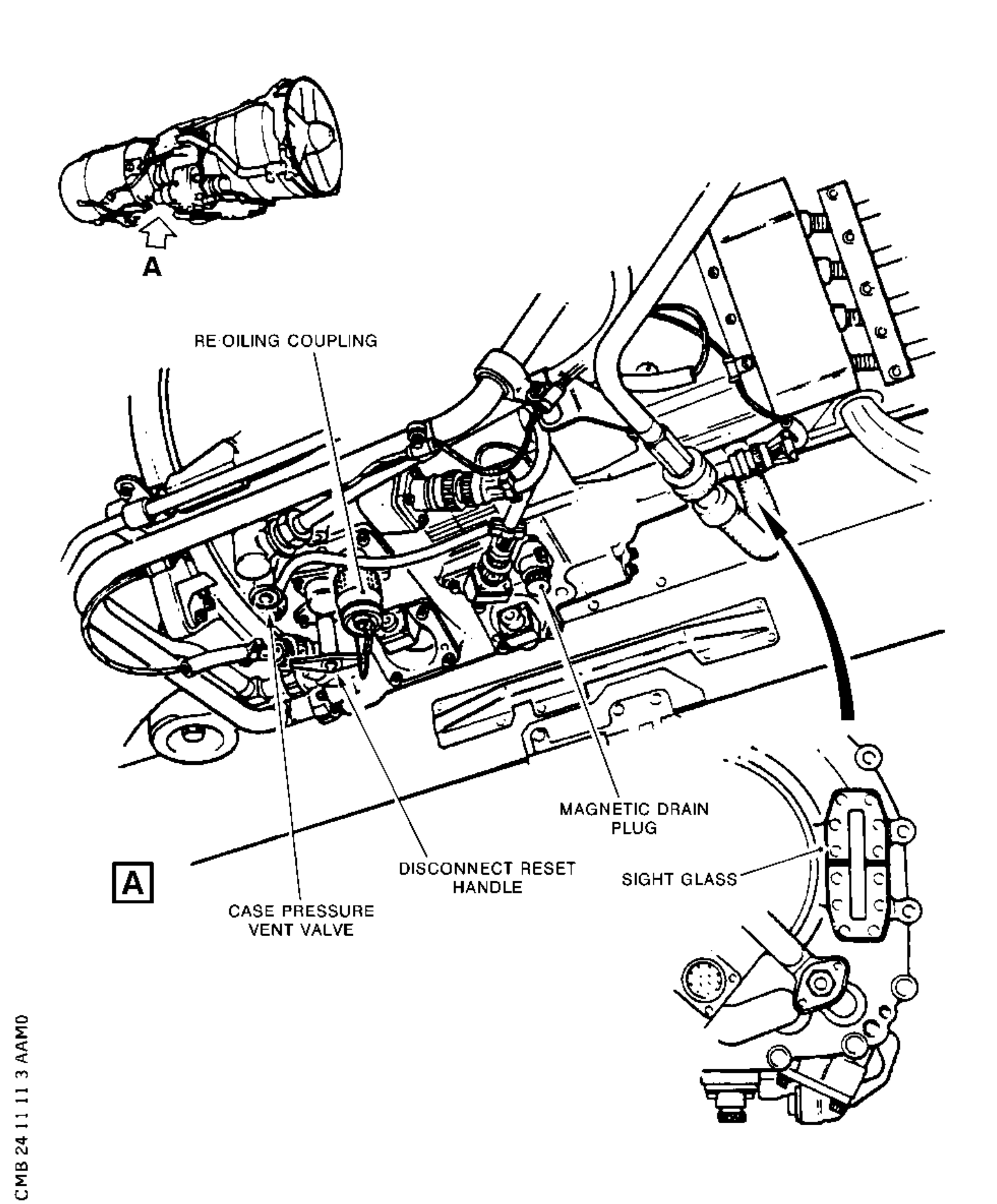
ENSURE THAT THE FILTER HAS NOT EXCEEDED ITS WORKING LIFE.

(1) Open the engine bay doors as required to gain access to the IDG (Ref. 71-00-00).

C. Fill and Prime

WARNING: AN IDG WHICH HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE.

CAUTION: DO NOT OVERFILL. OVERFILLING CAN CAUSE OVERHEATING AND OIL SLUDGING, RESULTING IN TRANSMISSION DAMAGE.



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IDG Equipment Location
Figure 301

(1) Vent the IDG case by pressing in the case pressure vent valve.

(2) Detach the quick-release cap of the re-oiling coupling by pushing up the sleeve and rotating it to release the locking balls.

(3) Connect the delivery hose of the replenishing gun to the re-oiling coupling.

(4) Fill the IDG carefully with oil until the oil reaches the top of the oil level mark on the sight glass.

(5) Close the case pressure vent valve by pulling it out to its full extent.

(6) Disconnect the re-oiling delivery hose and assemble the quick-release cap to the re-oiling coupling. Ensure that the sleeve is in the locked position and the cap is secure.

(7) Pull the disconnect reset handle to ensure that the IDG is engaged.

(8) Carry out an engine dry motoring cycle (Ref. Chap.71). This is to ensure that the IDG and oil system are fully primed.

(9) Vent the IDG case by pressing in the case pressure vent valve. Allow at least 5 min for the oil levels to equalize within the IDG.

(10) Check that the oil level is within the oil level mark on the sight glass. If the oil level is correct, ignore the following operations (11) and (12).

(11) If the oil is below the correct level, proceed as follows:-

(a) Detach the quick-release cap of the re-oiling coupling by pushing up the sleeve and rotating it to release the locking balls.

(b) Connect the delivery hose of the replenishing gun to the re-oiling coupling.

(c) Add more oil through the re-oiling coupling as required to ensure that the correct level is established at the sight glass.

(d) Disconnect the re-oiling delivery hose and assemble the quick-release cap to the re-oiling coupling. Ensure that the sleeve is in the locked position and the cap is secure.

(e) Carry out an engine dry motoring cycle (Ref. Chap.71) to ensure that the IDG and oil system are fully primed.

(12) If the oil is above the correct level, proceed as follows:-

(a) Place a container beneath the IDG magnetic drain plug.

CAUTION: ENSURE THAT THE MAGNETIC DRAIN PLUG IS PROTECTED FROM EXTERNAL CONTAMINATION AND ISOLATED FROM FERROUS METAL AND OTHER MAGNETIC PLUGS.

(b) Clean the area around the magnetic drain plug.

(c) Remove the magnetic drain plug by pressing in, rotating counter-clockwise and gently withdrawing it.

NOTE: The close fitting of the magnetic drain plug sealing rings may cause some resistance to be felt while the plug is being withdrawn.

(d) Fit the drain hose in place of the magnetic plug by pressing in the adapter end and rotating it clockwise; oil will flow through the drain hose. When the appropriate amount of oil has been drained off into the container, remove the drain hose by rotating the adapter end counter-clockwise and withdrawing it.

(e) Check that the correct oil level is established at the sight glass.

(f) Ensure that two serviceable sealing rings are fitted to the magnetic drain plug, then refit the plug by pressing it in and rotating it clockwise. Ensure that the plug is correctly installed, by checking that the three indentations on the plug are coincident with those on the self-closing valve body.

(13) Close the case pressure vent valve by pulling it out to its full extent.

D. Conclusion

(1) Close the engine bay doors (Ref. 71-00-00)

3. IDG Oil System - Draining (Ref. Fig. 301)

A. Equipment and Materials

DESCRIPTION	PART NO.
Drain hose, for draining oil from the IDG to adjust oil level. (Fitted in place of the magnetic drain plug, this lifts an internal self-closing valve).	OL-VDB 3315 Vatric

B. Prepare

(1) Open the engine bay doors as required to gain access to the IDG (Ref. 71-00-00).

C. Drain

(1) Place a container beneath the IDG magnetic drain plug to receive the IDG oil content (approx. 9 litres).

WARNING: AN IDG WHICH HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE.

CAUTION: ENSURE THAT THE MAGNETIC DRAIN PLUG IS PROTECTED FROM EXTERNAL CONTAMINATION AND ISOLATED FROM FERROUS METAL AND OTHER MAGNETIC PLUGS.

(2) Vent the IDG case by pressing in the case pressure vent valve.

(3) Clean the area around the magnetic drain plug.

(4) Remove the magnetic drain plug by pressing in, rotating counter-clockwise and gently withdrawing it.

NOTE: The close fitting of the magnetic drain plug sealing rings may cause some resistance to be felt while the plug is being withdrawn.

(5) Inspect the magnetic drain plug for contamination (Ref. 24-11-11, Inspection/Check).

(6) Fit the drain hose in place of the magnetic drain plug by pressing in the adapter end and rotating it clockwise; oil will flow through the drain hose. When the IDG oil content has drained into the container, remove the drain hose by rotating the adapter end counter-clockwise and withdrawing it.

(7) Ensure that two serviceable sealing rings are fitted to the magnetic drain plug, then refit the plug by pressing it in and rotating it clockwise. Ensure that the plug is correctly installed, by checking that the three indentations on the plug are coincident with those on the self-closing valve body.

(8) Close the case pressure vent valve by pulling it out to its full extent.

D. Conclusion

(1) Place a warning placard on the IDG stating that the IDG has been drained of operating oil.

4. IDG Oil System - Flushing

A. Prepare

CAUTION: IF CONTAMINATION OF THE IDG OIL SYSTEM IS SUSPECTED OR IF THE IDG WAS LAST RUN WITH OIL OF A TYPE DIFFERENT FROM THAT TO BE USED FOR REFILLING , THE IDG CHARGE OIL FILTER AND IDG SCAVENGE FILTER ELEMENTS MUST BE RENEWED.

(1) Open the engine bay doors as required to gain access to the IDG (Ref. 71-00-00).

(2) Refer to the CAUTION. If necessary, renew the IDG charge oil filter and scavenge filter elements (Ref. 24-11-11, Removal/Installation).

B. Flush

(1) If not already drained, drain the IDG (Ref. para.3.).

(2) Fill and prime the IDG as detailed in para.2., but omitting operations (9) to (12) inclusive.

(3) Drain the IDG (Ref. para.3).

(4) Fill and prime the IDG (Ref. para.2).

5. IDG Input Shaft Oil Seal Drain Pipe - Blanking-off Procedure (Ref. Fig. 302)

CAUTION: THE CONDITIONS FOR BLANKING-OFF AN IDG INPUT SHAFT OIL SEAL DRAIN PIPE ALLOW TWO IDGs PER AIRCRAFT TO
RB BE BLANKED-OFF AT ANY ONE TIME. THE MAXIMUM PERIOD
RB FOR IDGs TO BE BLANKED FOR IS RETURN TO LHR ONLY.

B NOTES TO CREW AND CARRY FORWARD ACTION ARE REQUIRED.

B BLANKED IDGs MUST NOT BE SWAPPED FROM ENGINE TO
B ENGINE. THE IDG MUST BE SENT TO WORKSHOPS FOR
B SEAL REPLACEMENT, SPECIFY WHETHER OIL LOSS IS
B ENGINE OR IDG.

A. Equipment and Materials

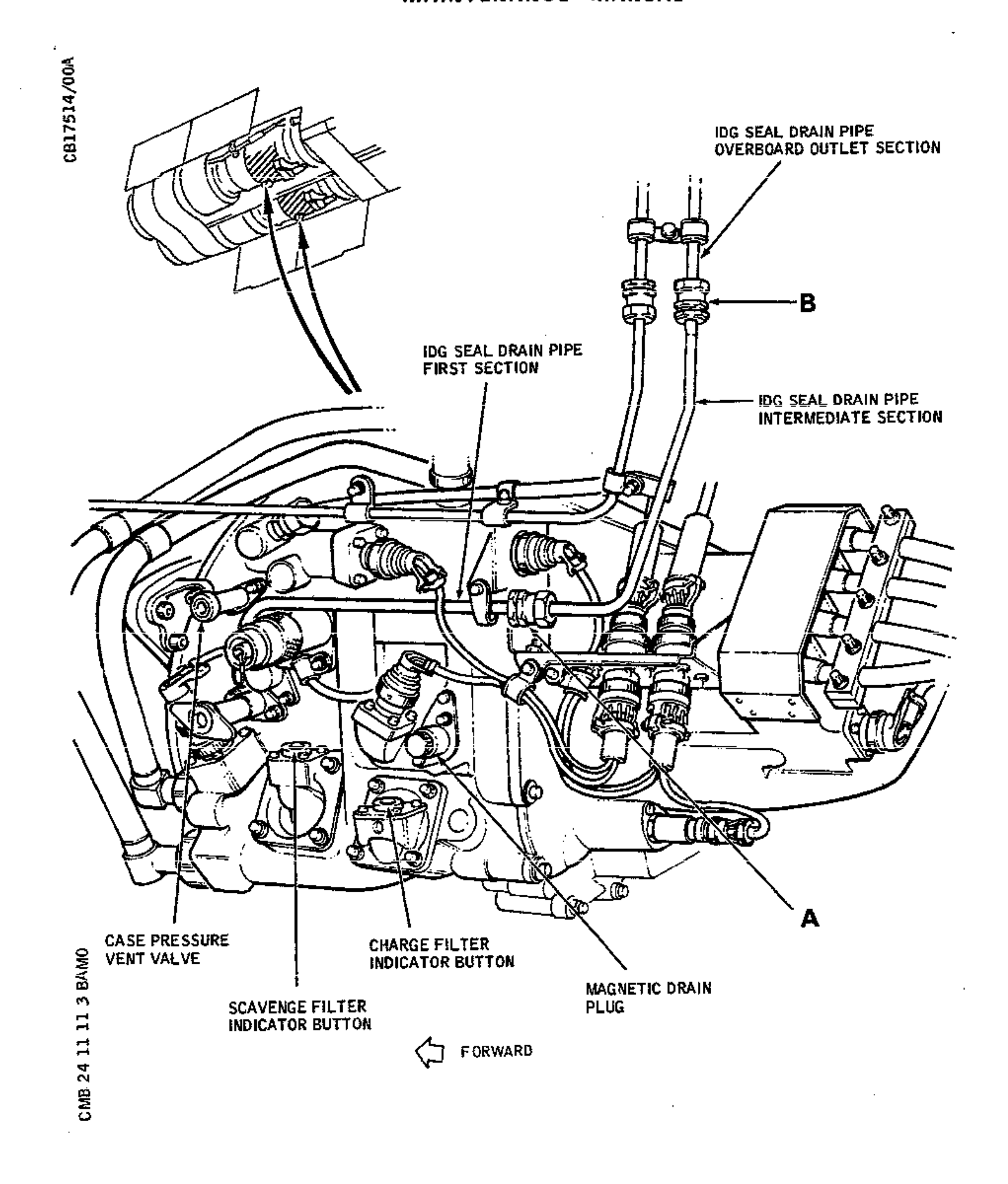
DESCRIPTION	PART NO.
Pipe closure nut assembly (qty. 2)	AS15826
Pipe union body (qty. 1)	AS27468
Torque spanner, 140 to 160 lbf in (1.580 to 1.808 mdaN)	-
Locking wire, 0.036 in (91 mm) dia.	-

B. Prepare

(1) Open the engine bay doors as required to gain access to the IDG (Ref. 71-00-00).

C. Fit Blanks to IDG Seal Drain Pipe

(1) Disconnect, remove and retain the intermediate



R - IDG Seal Drain Pipe - Blanking-off Points
Figure 302

section of the IDG seal drain pipe (Part No. E521150-001).

(2) Fit a pipe closure nut assembly (Part No.AS15826) to the first section of the IDG seal drain pipe (position A). Torque-tighten the union nuts to between 140 and 160 lbf in (1.580 and 1.808 mdaN). Wire-lock the nuts in accordance with 20-21-13.

(3) Fit a pipe union body (Part No.AS27468) and a pipe closure nut assembly (Part No.AS15826) to the over-board outlet section of the IDG seal drain pipe (position B). Torque-tighten the union nuts to between 140 and 160 lbf in (1.580 and 1.808 mdaN). Wire-lock the nuts in accordance with 20-21-13.

(4) Fit suitable blanks to the ends of the removed section of pipe and place the pipe in a clean plastic bag.

(5) Stow the pipe in the aircraft (for future use), as instructed by the senior engineer present.

(6) Record, in the appropriate document(s), the details of the action taken.

D. Conclusion

(1) Close the engine bay doors (Ref. 71-00-00).

INTEGRATED DRIVE GENERATOR - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

An integrated drive generator (IDG) is attached to an accessory gearbox on the right-hand side of each engine and is secured by a quick attach/detach (QAD) coupling ring.

The following removal and installation procedures include those for the IDG and those for IDG accessories which can be removed and installed with the IDG in situ. The removal/installation procedures applicable to the IDG are detailed in paragraph 2.; those applicable to IDG accessories are detailed under separate paragraphs as follows:-

Charge Filter Element (Ref. para.3.)

Scavenge Filter Element (Ref. para.4.)

Differential Pressure Indicator (Filter Indicator) (Ref. para.5.)

Pressure Switch (Ref. para.6.)

Temperature Probe (Ref. para.7.)

2. Integrated Drive Generator (Ref. Fig.401 and 402)

WARNING: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/INSTALLATION PROCEDURES.

AN IDG THAT HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE. ENSURE THAT THE IDG IS DEPRESSURIZED PRIOR TO THE REMOVAL OF THE IDG AND THE DRAINING OF THE OPERATING OIL FROM THE SYSTEM.

A. Equipment and Materials

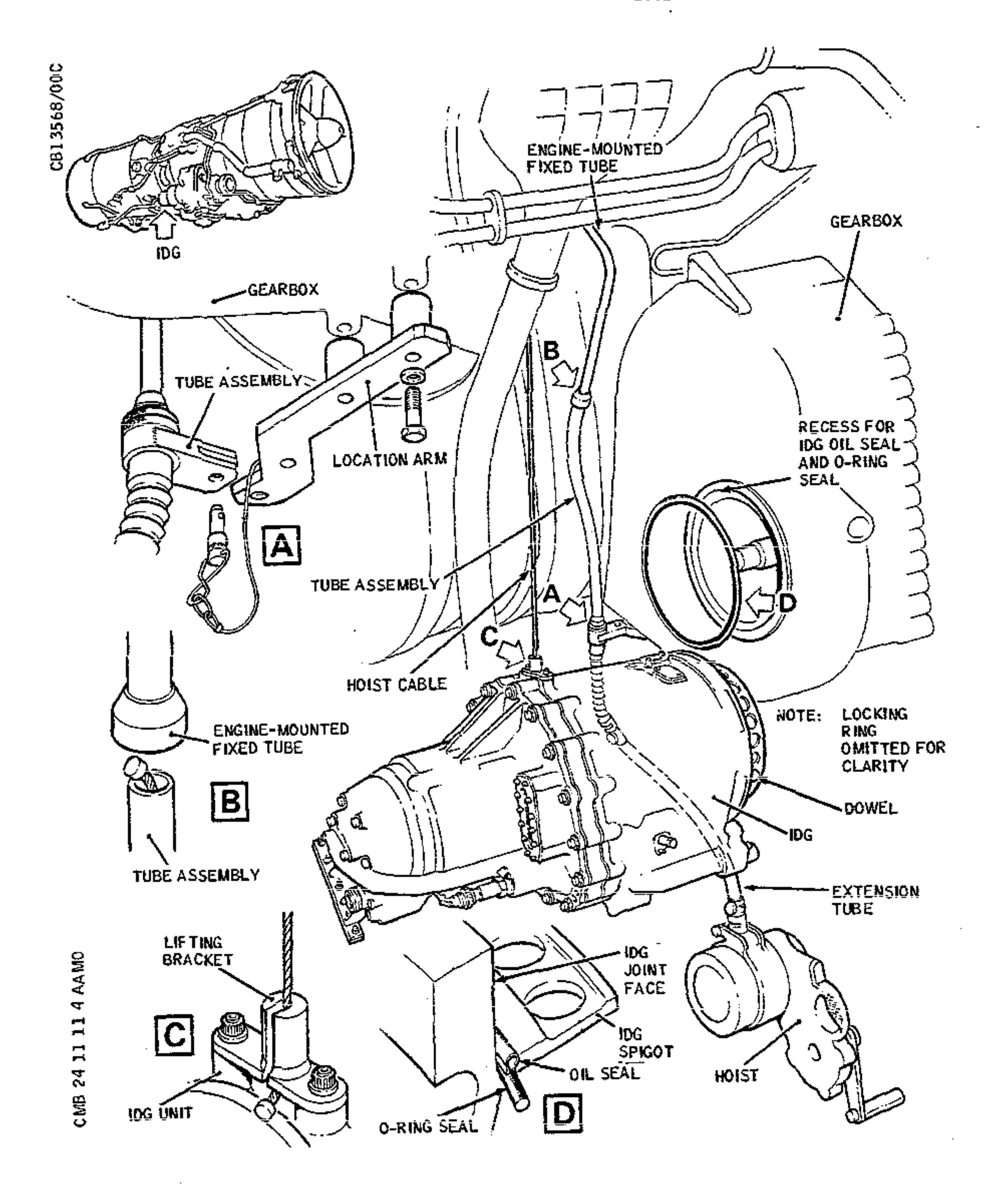
	DESCRIPTION	PART NO.
R	Hoist, 5 cwt (245 kg)	-
R	Winding handle, 9 in (230 mm)	-
R	Location arm	PE 29910
R	Tube assembly	PE 35784

Printed in England

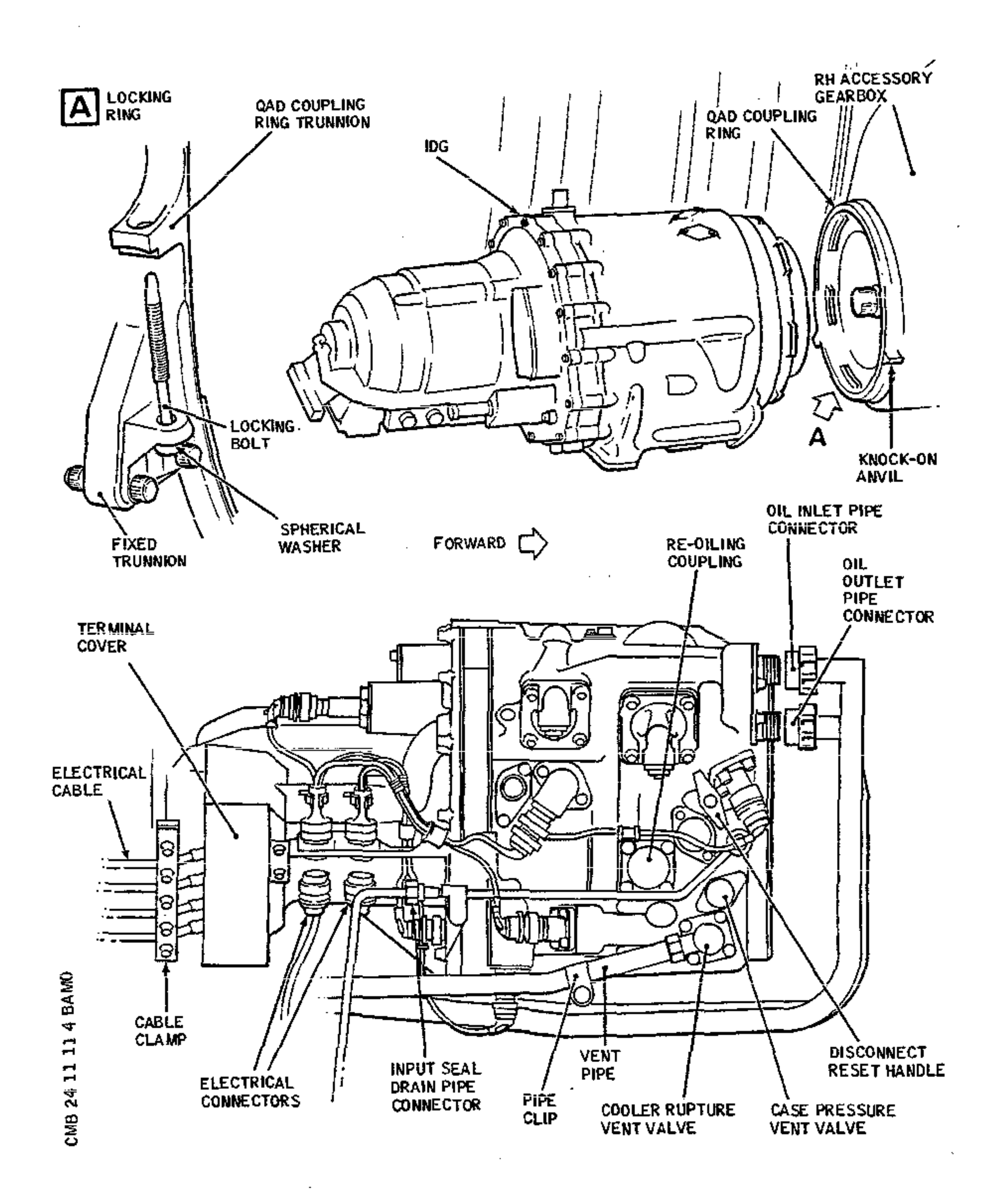
DESCRIPTION	PART NO.
Extension tube	-
R B Lubricant, for lubricating mating surfaces of IDG and engine accessory gearbox	Dow Corning No 4 grease
Oil to Spec. DERD2497, for lubricating the QAD coupling ring and locking bolt	-
Spanner, specified for hand-tightening the locking bolt of the QAD coupling ring	P5T1294406 (Rolls Royce)
Torque spanner, 6 to 20 lbf in (0.068 to 0.226 mdaN)	-
Torque spanner, 0 to 25 lbf in (0.00 to 0.28 mdaN)	-
Torque spanner, 140 to 160 lbf in (1.582 to 1.808 mdaN)	-
Torque spanner, 170 to 190 lbf in (1.921 to 2.147 mdaN)	-
Torque spanner, 190 to 210 lbf in (2.147 to 2.373 mdaN)	-
Torque spanner, 200 to 220 lbf in (2.26 to 2.48 mdaN)	-
Torque spanner, 400 to 440 lbf in (4.52 to 4.97 mdaN)	-
Locking wire, 0.036 in (0.91 mm) dia.	-

B. Prepare to Remove IDG

WARNING: THE IDG WEIGHS APPROXIMATELY 120 lb (54.5 kg). ADEQUATE PRECAUTIONS MUST BE TAKEN TO SUPPORT



- Integrated Drive Generator - Removal/Installation
R Figure 401



Integrated Drive Generator - Installation
Figure 402

THE ASSEMBLY DURING REMOVAL AND INSTALLATION.

THE PERMISSION OF THE SENIOR ENGINEER PRESENT MUST BE OBTAINED FOR THE REMOVAL OR INSTALLATION OF AN IDG WITH EXTERNAL POWER CONNECTED TO THE AIRCRAFT (REF. PARA.(3)(b)).

(1) Open the engine bay doors (Ref. 71-00-00).

(2) Display a placard in the flight compartment warning that personnel are working in the engine bay and forbidding the running of the engines.

(3) Electrically isolate the IDG as follows:-

(a) Either isolate the electrical generation and external power supplies as detailed in 24-00-00, or -

(b) if disconnection of external power supplies from the aircraft is inconvenient and only one IDG is to be removed, refer to the WARNING then, with permission, proceed as follows:-

B 1) Electrically isolate the associated accessories, i.e., the constant speed drive (CSD) disconnect solenoid, the pressure switch and the temperature probes, by tripping the appropriate circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
NO.1 CSD DISCON NO.2 OIL LP IND	1-213	1X310	R7
NO.2 CSD DISCON NO.1 OIL LP IND	1-213	2X310	R8
NO.3 CSD DISCON NO.4 OIL LP IND	3-213	3X310	G8
NO.4 CSD DISCON NO.3 OIL LP IND	3-213	4X310	G9
ENG 1 & 2 CSD OIL TEMP IND	15-215	D140	D2

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG 3 & 4 CSD OIL TEMP IND	15-216	D141	C25

B 2) If not already in use, make available electrical ground power as detailed in 24-41-00.

B 3) Check that all four generator circuit breaker (GCB) position magnetic indicators display cross-line.

(4) Disconnect the two electrical connectors from the IDG wiring harness.

(5) Disconnect the electrical connector from the generator.

(6) Remove the clamp securing the electrical cables to the generator.

(7) Remove the terminal cover from the generator and disconnect the electrical cables from the terminals (A, B, C and N). Refit the terminal cover.

(8) Depressurize the IDG by depressing the case pressure vent valve.

(9) Drain the IDG oil system (Ref. Servicing).

(10) Disconnect the oil inlet pipe and the oil outlet pipe at the IDG connectors.

(11) Disconnect the drain pipe which is clipped to the IDG cooler rupture valve vent pipe. Disconnect the pipe securing clips and remove the pipe.

NOTE: Removal of this pipe is necessary to provide clearance for removal of the IDG.

(12) Disconnect the cooler rupture valve vent pipe at the IDG coupling and the pipe joint. Disconnect the pipe securing clips and remove the vent pipe.

(13) Disconnect the IDG input seal drain pipe assembly

at the pipe connector.

(14) Fit suitable blanks to the oil pipelines and the IDG ports.

(15) Secure the location arm with two bolts and washers to the bracket on the bottom of the engine RH accessory gearbox.

(16) Engage the tube assembly with the fixed tube and attach the tube assembly to the location arm with the Pip pin.

(17) Fit the extension tube to the hoist and operate the hoist to extend the cable. Thread the cable through the extension tube, the tube assembly and the fixed tube.

(18) Secure the extension tube to the tube assembly and secure the ball head of the hoist cable to the lifting bracket on the IDG unit.

C. Remove IDG

CAUTION: WHENEVER AN IDG IS REMOVED BECAUSE OF POSSIBLE FAILURE, ENSURE THAT THE ASSOCIATED OIL COOLER AND CONNECTING PIPES ARE FREE FROM CONTAMINATION BEFORE THESE COMPONENTS ARE USED AGAIN.

(1) Support the weight of the IDG with the aid of the hoist.

(2) Unscrew and remove the locking bolt and spherical washer from the QAD coupling ring trunnion.

(3) Using a 1/2 lb (0.226 kg) hammer applied to a suitable drift against the face of the anvil, drive the coupling ring in a clockwise direction (viewed from rear end) until loose.

(4) Turn the coupling ring until the threads on the IDG and those of the coupling ring disengage.

(5) Withdraw the IDG from the accessory gearbox to disengage the gearbox drive shaft from the IDG splined drive.

(6) Operate the hoist to lower the IDG assembly onto a suitable support and remove the hoist cable from the IDG lifting bracket.

(7) Fit suitable blanks to the IDG and accessory gearbox mating surfaces, ensuring that serviceable seals are fitted to prevent the possibility of oil leakage.

(8) Refer to the CAUTION. If removal of the IDG was required because of possible failure, and contamination is evident or suspected, the IDG must be returned for overhaul together with a report giving details of the reason for removal.

(9) If contamination is evident or suspected, flush the oil cooler and oil pipelines as necessary to ensure freedom from contamination (Ref. 79-00-04).

D. Install IDG

CAUTION: BEFORE FITTING THE IDG UNIT TO THE ACCESSORY GEARBOX, ENSURE THAT THE THREADED SEGMENTS AND ABUTMENT FACES OF THE COUPLING RING, THE LOCKING BOLT, SPHERICAL WASHER, THE IDG UNIT FLANGE AND LOCATING DOWEL ARE CLEAN AND UNDAMAGED.

NOTE: SB 24-015 introduces a revised method for IDG joint seal location which is applicable whenever an IDG is installed. The following procedures are arranged accordingly.

(1) Comply with the electrical safety precautions.

(2) Ensure that the lifting equipment is correctly installed, then secure the ball head of the hoist cable to the IDG lifting bracket.

(3) Remove the blanks and seals from the IDG and accessory gearbox mating faces.

(4) Place a new oil seal and a new O-ring seal in correct position against the IDG joint face, i.e., the O-ring seal must be fitted over the IDG spigot with the oil seal located over the O-ring seal (Ref. Fig. 401) (Detail D).

(5) Lubricate the mating surfaces of the IDG and
R B accessory gearbox, with Dow Corning No 4 grease. Lubricate the QAD coupling ring segments, locking bolt and spherical washer with oil to spec. DERD 2497 (Ref. 20-30-00).

(6) Operate the hoist to raise the IDG unit in line

with the gearbox.

(7) Guide the IDG unit into engagement with the engine accessory gearbox, ensuring correct engagement with gearbox drive shaft and the IDG splined drive. Ensure that the dowel is correctly located.

(8) Press the IDG unit squarely into position until its joint face abuts that of the gearbox (taking care to ensure that the seal assembly is correctly aligned) and secure it with the QAD coupling ring
R (Ref.70-00-06) by engaging the threaded segments and turning in a counter-clockwise direction (viewed from rear end) as far as possible, by hand. Ensure that the coupling ring trunnion is in a position to be tightened to the fixed trunnion by the locking bolt.

CAUTION: ENSURE THAT THE THREADED SEGMENTS OF THE COUPLING RING HAVE ENGAGED FREELY BEFORE TIGHTENING.

(9) Insert the locking bolt, together with the sphercial washer, into the fixed trunnion and screw the bolt into the spherical nut of the coupling ring trunnion.

(10) Measure the run-down torque of the locking bolt, i.e., screw in the locking bolt until the load faces (bolt head and spherical washer) are not quite in contact, and measure the torque required to turn the bolt. The run-down torque must be between 6 and 20 lbf in (0.068 and 0.226 mdaN).

(11) Screw in and hand-tighten the locking bolt with the specified spanner, using one hand only.

NOTE: This operation provides a positive full run-down of the locking bolt near to the final tightening position without exceeding the torque loading limit.

(12) Torque-tighten the locking bolt to between 170 and 190 lbf in (1.921 and 2.147 mdaN).

(13) Tap radially around the periphery of the coupling ring where accessible, using a hide-face hammer or a 1/2 lb (0.266 kg) hammer and aluminium drift to ensure equal disposition of the ring.

(14) Measure the torque loading now remaining on the locking bolt.

(15) Repeat operations (12), (13) and (14) until -

(a) there is less than 18 lbf in (0.203 mdaN) difference between the torque loading specified in operation (12) and the torque loading remaining as measured in operation (14), and

(b) the bolt is torque-tightened to between 170 and 190 lbf in (1.921 and 2.147 mdaN).

(16) Operate the hoist to extend the cable and disengage the cable from the IDG lifting bracket.

(17) Detach the extension tube from the tube assembly and withdraw the cable.

(18) Operate the hoist to withdraw the cable through the extension tube and disengage the extension tube from the hoist.

(19) Detach the tube assembly from the location arm by removing the Pip pin, then unbolt and remove the location arm from the accessory gearbox.

(20) Detach the tube assembly from the fixed tube.

(21) Remove the blanks from the oil pipelines and the IDG ports.

(22) Secure the oil inlet and oil outlet pipes to the IDG. Torque-tighten the pipe union nuts to between 400 and 440 lbf in (4.53 and 4.97 mdaN). Wire-lock the nuts in accordance with 20-21-13.

(23) Connect the cooler rupture vent pipe and securing clips to the IDG. Torque-tighten the pipe union nuts to between 200 and 220 lbf in (2.26 and 2.486 mdaN). Wire-lock the nuts in accordance with 20-21-13.

(24) Connect the drain pipe to the IDG input seal drain assembly and torque-tighten the nut to between 140 and 160 lbf in (1.58 and 1.808 mdaN). Wire-lock the nut in accordance with 20-21-13.

(25) Refit the drain pipe and securing clips removed in operation B.(11). Torque-tighten the pipe union nuts to between 140 and 160 lbf in (1.580 and 1.808 mdaN). Wire-lock the nuts in accordance with 20-21-13.

(26) Connect the two electrical connectors to the IDG wiring harness and connect the electrical connector to the generator, ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock the connectors (Ref. Wiring Diagram Manual, 20-42-48).

(27) Remove the terminal cover on the generator and connect the four electrical cables to the terminals (A, B, C and N), ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminal nuts to between 190 and 210 lbf in (2.147 and 2.373 mdaN).

(28) Refit the cable clamp and torque-tighten the securing nuts to 25 lbf in (0.281 mdaN).

(29) Refit the terminal cover.

(30) Pull the disconnect reset handle on the IDG to ensure that the transmission is engaged.

B (31) Flush, fill and prime the IDG system (Ref. Servicing).

R <u>NOTE</u>: IDGs supplied at Pre Mod 2284 are to be filled
R with ENCO 2380 oil. (Ref. Servicing).

R IDGs supplied at Post Mod 2284 are to be filled
R with ETO 25 oil. (Ref. Servicing).
R

E. Conclusion

(1) Remove the warning placard from the flight compartment.

(2) Cancel the electrical isolation precautions taken before removal (Ref. operations B. (3) (a)), or reset the circuit breakers tripped before removal (Ref. operations B. (3) (b)), as applicable.

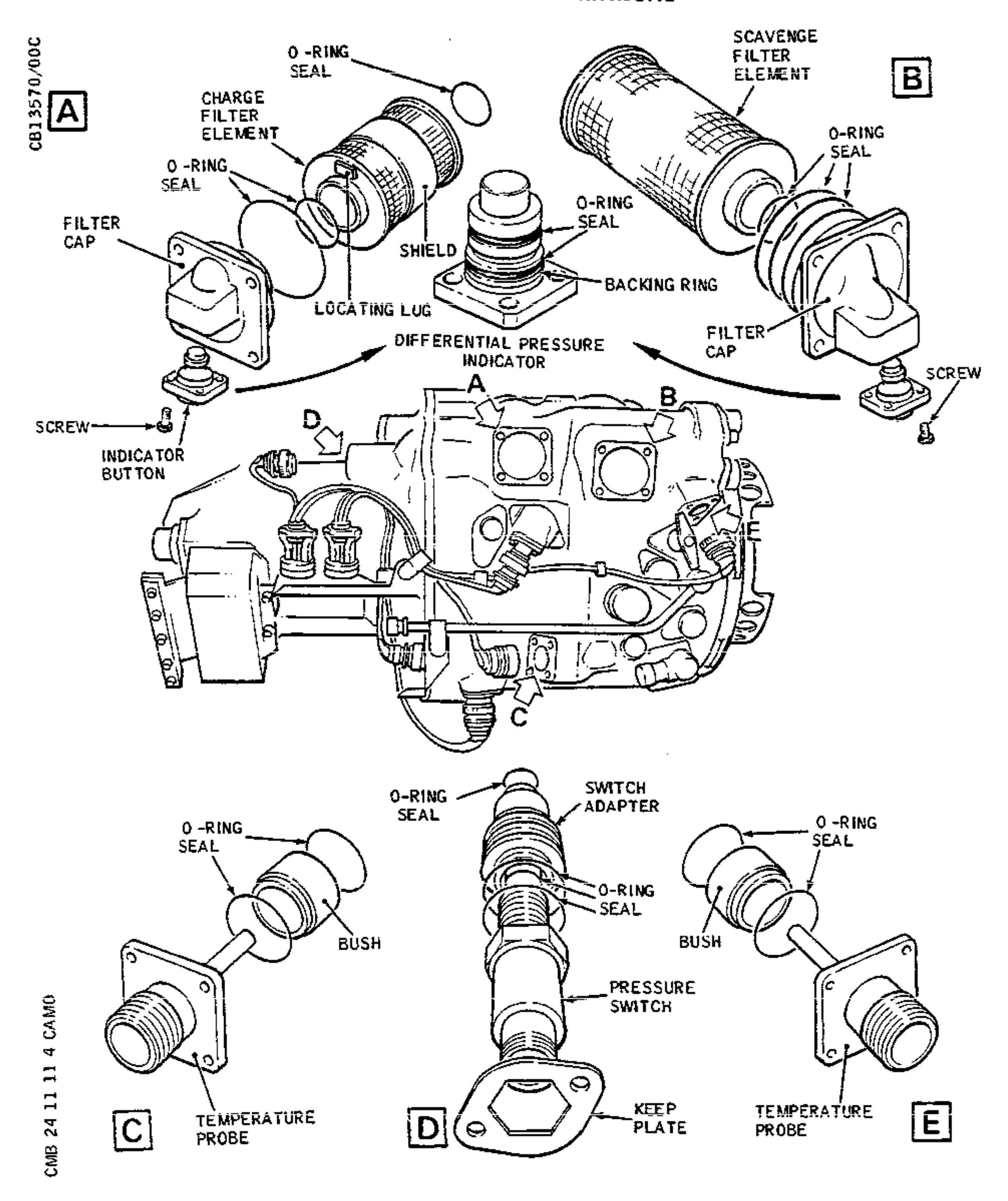
(3) Carry out an Operational Test of the IDG (Ref. Adjustment/Test).

RB (4) The torque loading on the IDG locking bolt must be
RB checked (Ref. operations D. (13) to (15)) at next
RB return to LHR or 4 sectors, whichever is the sooner.
RB Raise a Cat Q ADD with the above text and the IDG
RB position to be checked, to ensure this torque check is
RB carried out.

3. Charge Filter Element (Ref. Fig. 403)

WARNING: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/ INSTALLATION PROCEDURES.

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- Integrated Drive Generator Accessories - Installation
Figure 403

AN IDG THAT HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE. ENSURE THAT THE IDG IS DEPRESSURIZED PRIOR TO THE REMOVAL OF THE CHARGE FILTER OR DRAINING OF THE OPERATING OIL.

A. Equipment and Materials

DESCRIPTION	PART NO.
Lubricant	Acriloid HF-825
Torque spanner, 0 to 3.8 lbf in (0 to 0.043 mdaN)	-
Torque spanner, 94 to 100 lbf in (1.062 to 1.13 mdaN).	-

B. Prepare to Remove Charge Filter Element

(1) Display a placard in the flight compartment warning that personnel are working in the engine bay and forbidding the running of the engines.

(2) Open the engine bay doors (Ref. 71-00-00).

(3) Depress the case pressure vent valve to depressurize the IDG.

C. Remove Charge Filter Element

(1) Unscrew the bolts securing the charge filter cap to the input housing. Screw two filter securing bolts into the jacking threads in the filter cap and tighten the bolts until the filter cap is lifted from the input housing.

NOTE: When the filter cap is loosened approximately 100 ml of operating oil will flow from the charge filter.

(2) Remove the filter cap from the IDG housing, discard the attached O-ring seal and unscrew the two jacking bolts.

(3) Withdraw the filter element from the IDG housing and discard it complete with the O-ring seals.

(4) Clean the filter cavity with a lint-free cloth moistened with IDG operating oil.

(5) If contamination of the operating oil is evident or suspected, drain and flush the IDG system (Ref. Servicing).

D. Install Charge Filter Element

CAUTION: WHEN INSTALLING THE CHARGE FILTER ELEMENT, ENSURE THAT THE LOCATING LUG PROTRUDING FROM THE FILTER ELEMENT IS ENGAGED BY THE SLOT IN THE FILTER CAP.

NOTE: When available, Acriloid HF-825 must be used in preference to IDG operating oil for the lubrication of seals, particularly where retention of a seal is required in addition to lubrication.

(1) Lubricate the new O-ring seals and attach one at each end of a new filter element. Fit the filter element into the filter cavity, ensuring that the outlet boss is seated correctly in its locating bore.

(2) Lubricate a new O-ring seal and position it on the filter cap. Lubricate the threads of the securing bolts with IDG operating oil and secure the filter cap in the housing, tightening the bolts evenly against the resistance of the O-ring seal.

(3) When the filter cap is seated firmly in position, slacken the securing bolts and check that the run-down torque of each bolt in its Screwlock insert is not less than 3.8 lbf in (0.043 mdaN). If any insert does not meet this requirement, remove the filter cap and fit a new Screwlock insert (Ref. Approved Repairs). Finally torque-tighten the securing bolts to between 94 and 100 lbf in (1.062 and 1.13 mdaN).

E. Conclusion

(1) If the indicator button in the filter cap is protruding, reset it.

(2) Fill and prime the IDG as required (Ref. Servicing).

(3) Check for oil leakage around the filter cap.

(4) Remove the warning placard placed in the flight

compartment before removal of the filter element.

(5) Carry out an Operational Test of the IDG (Ref. Adjustment/Test.

4. Scavenge Filter Element (Ref. Fig. 403)

WARNING: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/ INSTALLATION PROCEDURES.

AN IDG THAT HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE. ENSURE THAT THE IDG IS DEPRESSURIZED PRIOR TO THE REMOVAL OF THE SCAVENGE FILTER OR DRAINING OF THE IDG OPERATING OIL.

A. Equipment and Materials

DESCRIPTION	PART NO.
Lubricant	Acriloid HF-825
Torque spanner, 0 to 3.8 lbf in (0 to 0.43 mdaN)	-
Torque spanner, 94 to 100 lbf in (1.06 to 1.13 mdaN)	-

B. Prepare to Remove Scavenge Filter Element

(1) Display a placard in the flight compartment warning that personnel are working in the engine bay and forbidding the running of the engines.

(2) Open the engine bay doors (Ref. 71-00-00).

(3) Depress the case pressure vent valve to depressurize the IDG system.

C. Remove Scavenge Filter Element

(1) Unscrew the bolts securing the filter cap to the input housing. Screw two filter cap securing bolts into the jacking threads in the filter cap and tighten the bolts until the filter cap is lifted from the input housing.

NOTE: When the filter cap is loosened approximately 100 ml of operating oil will flow from the

scavenge filter.

(2) Remove the filter cap from the IDG housing, discard the filter cap O-ring seals and unscrew the two jacking bolts.

(3) Withdraw the filter element, complete with O-ring seal, from the input housing and discard the element and seal.

(4) Clean the filter cavity with a lint-free cloth moistened with IDG operating oil.

(5) If contamination of the operating oil is evident or suspected, drain and flush the IDG system (Ref. Servicing).

D. Install Scavenge Filter Element

NOTE: When available, Acriloid HF-825 must be used in preference to IDG operating oil for the lubrication of seals, particularly where retention of a seal is required in addition to lubrication.

(1) Lubricate two new O-ring seals for the filter cap and place the seals onto the cap. Lubricate a new O-ring seal and position it in the bore of a new filter element.

(2) Fit the filter element into the filter cap and place the filter element into the input housing. Secure the filter cap with the securing bolts, tightening the bolts evenly against the resistance of the O-ring seals.

(4) When the filter cap is seated firmly in position, slacken the securing bolts and check that the run-down torque of each bolt in its Screwlock insert is not less than 3.8 lbf in (0.43 mdaN). If any insert does not meet this requirement, remove the filter cap and fit a new Screwlock insert (Ref. Approved Repairs). Finally torque-tighten the securing bolts to between 94 and 100 lbf in (1.06 and 1.13 mdaN).

E. Conclusion

(1) If the indicator button in the filter cap is protruding, reset it.

(2) Fill and prime the IDG as required (Ref. Servicing).

(3) Check for oil leakage around the filter cap.

(4) Remove the warning placard placed in the flight compartment before removal of the filter element.

(5) Carry out an Operational Test of the IDG (Ref. Adjustment/Test).

5. Differential Pressure Indicator (Ref. Fig. 403)

WARNING: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/ INSTALLATION PROCEDURES.

AN IDG THAT HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE. ENSURE THAT THE IDG SYSTEM IS DEPRESSURIZED PRIOR TO THE REMOVAL OF THE DIFFERENTIAL PRESSURE INDICATOR.

A. Equipment and Materials

DESCRIPTION	PART NO.
Lubricant	Acriloid HF-825
Torque spanner, 0 to 1.0 lbf in (0 to 0.011 mdaN)	-
Torque spanner, 7 to 8 lbf in (0.079 to 0.90 mdaN)	-

B. Prepare to Remove Differential Pressure Indicator

(1) Display a placard in the flight compartment warning that personnel are working in the engine bay and forbidding the running of the engines.

(2) Open the engine bay doors (Ref. 71-00-00).

(3) Depress the case pressure vent valve to depressurize the IDG system.

C. Remove Differential Pressure Indicator

(1) Unscrew the screws securing the differential pressure indicator to the filter cap and remove the indicator.

NOTE: When the indicator is loosened, approximately 100 ml of operating oil will flow from the

filter cap.

(2) Remove the two O-ring seals and the backing ring from the indicator. Discard the two O-ring seals.

D. Install Differential Pressure Indicator

NOTE: When available, Acriloid HF-825 must be used in preference to IDG operating oil for the lubrication of seals, particularly where retention of a seal is required in addition to lubrication.

(1) Lubricate two new O-ring seals and the backing ring. Place the backing ring on the indicator, followed by the larger seal and then the smaller seal.

RB (2) Position the indicator and its spring on the filter cap and secure it with the securing screws, tightening the screws evenly against the resistance of the O-ring seals.

(3) When the indicator is seated firmly in position, slacken the securing screws and check that the run-down torque of each bolt in its Screwlock insert is not less than 1.0 lbf in (0.011 mdaN). If any insert does not meet this requirement, remove the indicator and fit a new Screwlock insert (Ref. Approved Repairs). Finally torque-tighten the securing screws to between 7 and 8 lbf in (0.079 and 0.090 mdaN).

E. Conclusion

(1) If the differential pressure indicator button is protruding, reset it.

(2) Fill and prime the IDG as required (Ref. Servicing).

(3) Check for oil leakage around the differential pressure indicator.

(4) Remove the warning placard placed in the flight compartment before removal.

(5) Carry out an Operational Test of the IDG (Ref. Adjustment/Test).

6. Pressure Switch (Ref. Fig. 403)

WARNING: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/ INSTALLATION PROCEDURES.

AN IDG THAT HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE. ENSURE THAT THE IDG SYSTEM IS DEPRESSURIZED PRIOR TO THE REMOVAL OF THE PRESSURE SWITCH.

A. Equipment and Materials

DESCRIPTION	PART NO.
Lubricant	Acriloid HF-825
Circuit breaker safety clips	-
Torque spanner, 0 to 2.1 lbf in (0 to 0.024 mdaN)	-
Torque spanner, 38 to 42 lbf in (0.429 to 0.475 mdaN)	-
Torque spanner, 90 to 100 lbf in (0.017 to 1.130 mdaN)	-
Locking wire 0.036 in (0.91 mm) dia	-

B. Prepare to Remove Pressure Switch

(1) Electrically isolate the appropriate pressure switch by tripping the associated circuit breaker listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
No.1 CSD DISCON No.2 OIL LP IND	1-213	1X310	R7
No.2 CSD DISCON No.1 OIL LP IND	1-213	2X310	R8
No.3 CSD DISCON No.4 OIL LP IND	3-213	3X310	G8
No.4 CSD DISCON No.3 OIL LP IND	3-213	4X310	G9

(2) Display a placard in the flight compartment warning that personnel are working in the engine bay and forbidding the running of the engines.

(3) Open the engine bay doors (Ref. 71-00-00).

(4) Depress the case pressure vent valve to depressurize the IDG.

C. Remove Pressure Switch

(1) Disconnect the electrical connector from the pressure switch.

(2) Remove the bolts securing the pressure switch keep plate and detach the keep plate.

(3) Withdraw the pressure switch assembly and unscrew the pressure switch from the switch adapter. Discard the O-ring seal from the pressure switch and the three O-ring seals from the adapter.

D. Install Pressure Switch

NOTE: When available, Acriloid HF-825 must be used in preference to IDG operating oil for the lubrication of seals, particularly where retention of a seal is required in addition to lubrication.

(1) Comply with the electrical safety precautions.

(2) Lubricate new O-ring seals and position them on the adapter and pressure switch.

(3) Screw the pressure switch into the adapter. Torque-tighten the pressure switch nut to between 90 and 100 lbf in (1.017 and 1.130 mdaN).

(4) Position the pressure switch and adapter in the generator housing and align the pressure switch connector keyway with that of the associated electrical cable connector.

(5) Place the keep plate over the pressure switch and secure it with the bolts, tightening evenly against the resistance of the O-ring seals.

(6) When the pressure switch is seated firmly in position, slacken the bolts and check that the run-down torque of each bolt in its Screwlock insert is not less than 2.1 lbf in (0.024 mdaN).

If any insert does not meet this requirement, remove the pressure switch and fit a new Screwlock insert (Ref. Approved Repairs). Finally torque-tighten the securing bolts to between 38 and 42 lbf in (0.429 and 0.475 mdaN).

(7) Connect the electrical connector to the pressure switch, ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

E. Conclusion

(1) Check the IDG oil level (Ref. Inspection/Check).

(2) Check for oil leakage around the pressure switch.

(3) Remove the warning placard placed in the flight compartment before removal.

(4) Remove the safety clip and reset the circuit breaker tripped before removal.

(5) Carry out an Operational Test of the IDG (Ref. Adjustment/Test).

7. Temperature Probe (Ref. Fig. 403)

WARNING: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/INSTALLATION PROCEDURES.

AN IDG THAT HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE. ENSURE THAT THE IDG SYSTEM IS DEPRESSURIZED PRIOR TO THE DRAINING OF THE IDG OPERATING OIL AND THE REMOVAL OF THE TEMPERATURE PROBE

A. Equipment and Materials

DESCRIPTION	PART NO.
Lubricant	Acriloid HF-825
Circuit breaker safety clips	-
Torque spanner, 0 to 3.8 lbf in (0 to 0.043 mdaN)	
Torque spanner, 94 to 100 lbf in (1.062 to 1.13 mdaN)	-

DESCRIPTION	PART NO.
Locking wire 0.036 in (0.91 mm) dia	-

B. Prepare to Remove Temperature Probe

(1) Place a placard in the flight compartment warning that personnel are working in the engine bay and forbidding the running of the engines.

(2) Open the engine bay doors (Ref. 71-00-00).

(3) Electrically isolate the appropriate temperature probe by tripping the associated circuit breaker listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG 1 & 2 CSD OIL TEMP IND	15-215	D140	D2
ENG 3 & 4 CSD OIL TEMP IND	15-216	D141	C25

C. Remove Temperature Probe

NOTE: When a temperature probe is being removed, approximately 500 ml of operating oil will flow from the 'oil in' temperature probe housing and 100 ml of oil will flow from the 'oil out' temperature probe housing.

(1) Disconnect the electrical connector from the appropriate temperature probe.

(2) Remove the bolts securing the temperature probe to the input housing and withdraw the temperature probe. Carefully remove the O-ring seal from the recess in the input housing and discard it.

D. Install Temperature Probe

NOTE: When available, Acriloid HF-825 must be used in preference to IDG operating oil for the lubrication of seals, particularly where retention of a seal is required in addition to lubrication.

(1) Comply with the electrical safety precautions.

(2) Lubricate a new O-ring seal and place it into the recess in the input housing.

(3) Fit the new temperature probe into the input housing and secure it with the securing bolts.

(4) When the temperature probe is seated firmly in position, slacken the securing bolts and check that the run-down torque of each bolt in its Screwlock insert is not less than 3.8 lbf in (0.043 mdaN). If any insert does not meet this requirement, remove the temperature probe and fit a new Screwlock insert (Ref. Approved Repairs). Finally torque-tighten the securing bolts to between 94 and 100 lbf in (1.062 and 1.13 mdaN).

(5) Connect the electrical connector to the temperature probe, ensuring that the mating surfaces are clean and undamaged. Tighten and wire-lock the connector (Ref. Wiring Diagram Manual, 20-42-48).

E. Conclusion

(1) Fill and prime the IDG system as required (Ref. Servicing).

(2) Check for oil leakage around the temperature probe seal.

(3) Remove the safety clip and reset the circuit breaker tripped before removal.

(4) Remove the warning placard placed in the flight compartment before removal.

(5) Carry out an Operational Test of the IDG (Ref. Adjustment/Test).

INTEGRATED DRIVE GENERATOR - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

NOTE: On the electrical generating control panel, the abbreviation CSD (constant speed drive) is used on associated control and indication equipment to identify the transmission component of the integrated drive generator (IDG) in each main generation channel.

The following Operational Test is primarily intended to
R check an IDG to confirm that it is operating correctly
R in the system either -

R (a) after installation of the IDG in the aircraft, or

R (b) after installation of an IDG accessory component where
R the removal/installation procedures have not required
R removal of the IDG.

R Differences in application of the Operational Test, as in (a))
R and (b) above, are detailed in the Test procedure. Functional
R and System Tests are not considered necessary in this
R application.

2. Operational Test

A. Prepare

NOTE: The following test and adjustment procedure is applicable to the IDG in No.1 main generation channel. It is equally applicable to an IDG in any one of the other three main generation channels by substitution of the appropriate channel numeration in respect of the engine, IDG and associated controls and indicators.

The application of this test procedure to an IDG is intended for single-channel operation only, i.e., the IDGs in the other three main generation channels must be switched off-line.

(1) Check the IDG oil level (Ref. 24-11-11, Inspection/Check).

(2) Make available electrical ground power as detailed in 24-41-00, Servicing.

(3) Ensure that the electrical power distribution system is set for normal operation, i.e., that the setting of controls and indicators is in accordance with the requirements for the connection of electrical ground power to the main d.c. distribution system (Ref. 24-41-00, Servicing, para.2.B.).

(4) Set Nos.1, 2, 3 and 4 generator control switches to "OFF" and check that the appropriate magnetic indicators remain cross-line and the associated GEN captions are illuminated.

(5) Set the A.C. FREQ/VOLTS selector switch to "GEN 1" and check that the voltage and frequency indications fall to near zero.

(6) Set the battery control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(7) Ensure that the emergency generator mode switch is at AUTO.

B. Test

(1) Start and run No.1 engine at ground idle, noting the procedures to be carried out if excessive CSD OIL
R INLET temperature is indicated during the engine run (Ref. 71-00-00). Check that the caption CSD 1 is extinguished and note the time at which the engine run commenced.

(2) Set and hold No.1 generator control switch at "TEST" and check that -

(a) No.1 GCB magnetic indicator remains cross-line,

(b) the caption GEN 1 remains illuminated, and

(c) the correct voltage, 115(+3 -5) V, and the frequency, approximately 400 Hz, are indicated.

(3) Release No.1 generator control switch to "OFF" and check that the voltage and frequency indications fall to near zero.

(4) Set No.1 generator control switch to "ON" and check that -

(a) No.1 GCB magnetic indicator changes from cross-

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line to in-line,

(b) the caption GEN 1 is extinguished, and

(c) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(5) Select, as necessary, such aircraft services as can be used to impose a total load greater than 40 kW but not exceeding 54 kW, as indicated on No.1 KW/KVAR meter. Check that the correct voltage, 115(+3 -5) V, and frequency, approximately 400 Hz, is indicated.

NOTE: If the frequency indication is unstable or erratic, the IDG must be renewed.

(6) Check that the IDG oil temperature is indicated on the INLET and DIFF scales of No.1 CSD oil temperature indicator.

NOTE: Under ground running conditions, the oil inlet temperature and differential temperature will be approximately 80 deg C and 15 deg C respectively. These values will vary according to the generator load and the ambient temperature.

(7) Check the time at which the engine run commenced and ensure that sufficient time has elapsed for the operation to stabilize.

NOTE: An engine running time of not less than 10 min is recommended to ensure that the IDG transmission output speed is stabilized to the degree necessary for the following test operations.

(8) Note precisely the frequency indication registered on the frequency meter and check that the frequency is maintained at a level within the limits of 396 and 404 Hz. If the indicated level of frequency is outside the limits of 396 and 404 Hz, the IDG governor, which effects control of the IDG transmission output speed, must be adjusted (Ref. 24-11-00, Adjustment/Test).

(9) Remove the aircraft loads from No.1 generator by holding No.1 generator control switch at "TEST" and note the frequency indicated on the frequency meter. Check that the frequency is maintained at a level within the limits of 396 and 404 Hz. If the frequency indication is unstable or erratic or deviates from these limits, the IDG must be renewed.

(10) Release the No.1 generator control switch to "OFF".

(11) If the test is being carried out to check the IDG after installation in the aircraft, continue at operation (12). If the test is being carried out to check the IDG after the installation of an accessory where the removal/installation procedures have not required removal of the IDG, continue at operation (13).

(12) Check the operation of the IDG disconnect/reset mechanism and the security of joints and seals as follows:-

CAUTION: DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

(a) Set the CSD disconnect switch to "DISC" and then release to "NORM". Check that the caption CSD 1 is illuminated, indicating, by loss of charge oil pressure, that the IDG is disconnected.

(b) Shut down No.1 engine (Ref. 71-00-00).

(c) Place a placard in the flight compartment to warn that personnel are working in the engine bay, then gain access to No.1 IDG. Open the engine bay doors as required (Ref. 71-00-00).

(d) Ensure that the locking bolt of the QAD coupling ring securing the IDG to the engine accessory gearbox is torque-tightened to the specified torque loading figure (Ref. Removal/Installation).

WARNING: THE IDG DISCONNECT RESET HANDLE MUST NOT BE OPERATED UNTIL ROTATION OF THE ASSOCIATED ENGINE HAS CEASED.

(e) Pull the IDG DISCONNECT reset handle as required to reset the disconnect mechanism.

NOTE: The IDG disconnect reset handle is located at the bottom of the IDG and labelled RESET WITH ENGINE STATIC. The reset handle is connected to a disconnect plunger which is spring-loaded and normally held retracted by engagement of the nose pin of the disconnect solenoid. When the disconnect solenoid is energized, the disconnect plunger is released and engages the disconnect mechanism so that the IDG is disconnected from the input (drive) shaft. The reset handle enables the disconnect plunger to be withdrawn to the position at which it is engaged by the solenoid nose pin.

(f) Inspect the IDG and connections for evidence of oil leakage. If leakage is detected, proceed as follows:-

f1) If there is leakage from the main joint faces, remove the IDG (Ref. Removal/
R Installation) and discard the oil seal and
R O-ring seal. Refit the IDG with a new oil
R seal and O-ring seal (Ref. Removal/
R Installation).

f2) If there is leakage from an accessory component, first renew the sealing ring(s); if leakage persists, renew the component (Ref. Removal/Installation).

(g) Ensure that all personnel are safely located and that the aircraft is safe for No.1 engine to be restarted (Ref. 71-00-00), then remove the warning placard from the flight compartment.

(h) Restart and run No.1 engine at ground idle (Ref. 71-00-00) and check that the caption CSD 1 is extinguished.

(i) Shut down No.1 engine (Ref. 71-00-00) and check that the caption CSD 1 is illuminated.

NOTE: The following operations (13), (14) and (15) are not applicable if operation (12) has been carried out.

(13) Shut down No.1 engine (Ref. 71-00-00) and check that the caption CSD 1 is illuminated.

(14) Place a placard in the flight compartment to warn that personnel are working in the engine bay, then gain access to No.1 IDG. Open the engine bay doors as required (Ref. 71-00-00).

(15) Inspect the IDG accessories for evidence of leakage. If there is leakage from an accessory component, first renew the sealing rings; if leakage persists, renew the component (Ref. Removal/Installation).

C. Conclusion

(1) Set BATT A and BATT B control switches to "OFF" and the A.C. FREQ/VOLTS selector switch to "GRND PWR".

(2) If applicable, remove the warning placard placed in operation B.(14).

(3) Switch off and disconnect electrical ground power as detailed in 24-41-00.

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INTEGRATED DRIVE GENERATOR - INSPECTION/CHECK

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00, SERVICING.

1. General

In related topics, the abbreviation CSD (constant speed drive) is used to identify the transmission component of the integrated drive generator (IDG).

Access to the IDG is obtained by opening the engine bay lower doors (Ref. 71-00-00). If renewal of an IDG is required, the details of the reason for removal must be recorded and returned with the removed IDG.

The inspection/check procedures are detailed under separate paragraphs as follows:-

Inspection/Check	(Ref. para.2.)
Oil - Level Check	(Ref. para.3.)
Filter - Condition Check	(Ref. para.4.)
Oil - Atomic Absorption and Acid Number Check (Sample)	(Ref. para.5.)
Oil - Fuel Contamination Check (Sample)	(Ref. para.6.)
Magnetic Drain Plug - Inspection/Check	(Ref. para.7.)

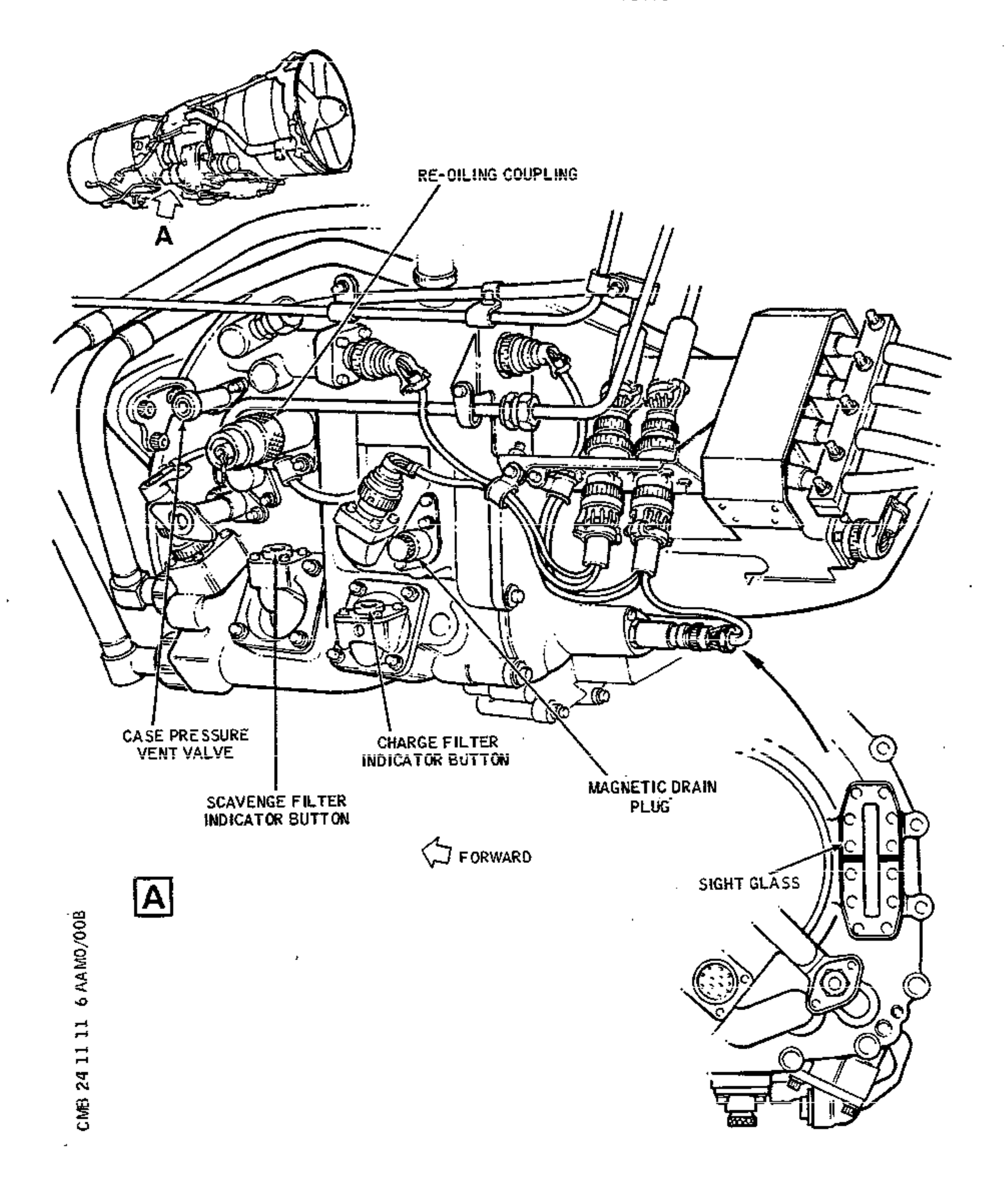
2. Inspection/Check (Ref. Fig. 601)

(1) Inspect the IDG and connections for evidence of oil leakage. If leakage is detected, proceed as follows:-

(a) If there is any leakage from the main joint faces, remove the IDG (Ref. Removal/Installation) and discard the oil seal and O-ring seal. Refit the IDG with a new oil seal and O-ring seal (Ref. Removal/Installation).

(b) If there is leakage from a minor component, first renew the sealing ring(s); if leakage persists, renew the component (Ref. Removal/ Installation).

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IDG Components
Figure 601

(2) Check the IDG oil level (Ref. para.3.).

(3) Inspect the magnetic drain plug for freedom from contamination. (Ref. para.7.).

(4) Check the condition of the charge oil filter and the scavenge filter (Ref. para.4.).

3. Oil - Level Check (Ref. Fig. 601)

A. Prepare

WARNING: AN IDG THAT HAS BEEN RECENTLY RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE.

(1) Vent the IDG case by pressing in the case pressure vent valve. Allow at least 5 min for the oil levels to equalize within the IDG.

B. Check

(1) Check that the IDG oil level is within the oil level mark on the sight glass. If the oil level is within the oil level mark, close the case pressure vent valve by pulling it out to its full extent.

R (2) If the oil level is low, replenish the IDG
R (Ref. 12-13-24).

R (3) If the oil level is high, and no recent oil
R filling has been done, this could indicate leakage
R of fuel into the oil from a damaged oil cooler.
R At the earliest opportunity, an oil sample must be
R taken and a Draeger contamination test made as
R detailed in paragraph 6. Adjust level in
R accordance with the procedures detailed in
R Servicing, paragraphs 2.C.(12) and (13).

NOTE: If an oil change is due, the charge oil filter element and the scavenge filter element must be renewed (Ref. Removal/ Installation) and the IDG must be drained and refilled with new operating oil (Ref. Servicing).

4. Filter - Condition Check (Ref. Fig. 601)

NOTE: Differential pressure indicators are fitted, one in the cap of the charge oil filter and one in the

cap of the scavenge filter. Indication of filter condition is given by a red button which protrudes from the filter cap when the filter element requires renewal.

A. Check Charge Oil Filter Indicator

(1) Examine the indicator button in the filter cap. If the button is protruding, renew the filter element (Ref. Removal/Installation).

B. Check Scavenge Filter Indicator

(1) Examine the red indicator button in the filter cap. If the button is protruding, renew the filter element (Ref. Removal/Installation).

5. Oil - Atomic Absorption and Acid Number Check (Sample)

CAUTION: TO OBTAIN SATISFACTORY AND CONSISTENT RESULTS IN SAMPLING THE IDG OIL, IT IS ESSENTIAL THAT SCRUPULOUS CLEANLINESS IS OBSERVED AT ALL TIMES.

NOTE: A sample should be taken before replenishing the IDG.

A. Equipment and Materials

DESCRIPTION	PART NO.
Oil sample bottle (60 ml) required for taking IDG oil samples.	-
RB Sampling nozzle, for attachment to oil sample bottle. Required to lift an internal self-closing valve at the magnetic drain plug orifice.	RRS3S12312000

B. Prepare

WARNING: AN IDG WHICH HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE.

(1) Vent the IDG case by pressing in the case pressure vent valve.

(2) Remove and inspect the magnetic drain plug for freedom from contamination (Ref. para. 7.).

CAUTION: THE OIL SAMPLE BOTTLE AND SAMPLING NOZZLE MUST BE FREE FROM CONTAMINATION. ENSURE THAT THE PROTECTIVE SEALING ENCLOSING THESE ITEMS IS INTACT.

(3) Remove the protective sealing from the sampling nozzle and the 60 ml oil sample bottle. Remove and retain the bottle top and assemble the sampling nozzle to the bottle.

C. Take Oil Sample

(1) Using the sampling nozzle to lift the internal self-closing valve, drain oil from the magnetic drain plug orifice into the sample bottle until the bottle is approximately two-thirds full. Remove the sampling nozzle then assemble, seal and secure the bottle top.

(2) Ensure that two serviceable sealing rings are fitted to the magnetic drain plug, then refit the plug by pressing it in and rotating it clockwise. Ensure that the plug is correctly installed, by checking that the three indentations on the plug are coincident with those on the self-closing valve body.

(3) Close the case pressure vent valve by pulling it out to its full extent.

RB (4) Despatch the oil sample as detailed in paragraph D.

RB (5) Check the IDG oil level (Ref. para. 3).

B D. Total Acid Number (T.A.N.) Oil Sampling

B (1) Sample IDG oil as detailed in the
B preceding paragraphs C.(1), (2)
B and (3).
R B USE PLASTIC OIL SAMPLING BOTTLE,
B PART No. GZAC 2776.

B (2) Label oil samples with the following
B information :-

B (a) Oil type Esso 2380

B (b) Aircraft registration :-

B (c) Aircraft position :-

B (d) I.D.G. S/No :-

B (e) Date :-

B (3) Despatch oil sample to :-

B Chemical Laboratory
B G2 TBA
R B S420

B (4) Check I.D.G. oil level (Ref. para. 3).

6. Oil - Fuel Contamination Check (Sample)

CAUTION: TO OBTAIN SATISFACTORY RESULTS IN SAMPLING THE IDG OIL, IT IS ESSENTIAL THAT SCRUPULOUS CLEANLINESS IS OBSERVED AT ALL TIMES.

NOTE: A sample should be taken as soon as possible after engine shut-down. The presence of fuel contamination in the oil system is detected by using the Draeger toxic gas detector kit and Draeger gas detector tube as detailed in the following procedures.

A. Equipment and Materials

DESCRIPTION	PART NO.
Oil sample bottle (60 ml), required for taking IDG oil samples.	-
Sampling nozzle, for attachment to oil sample bottle. Required to lift an internal self-closing valve at the magnetic drain plug orifice.	VSKM 5123 (Vactric)
Draeger toxic gas detector kit, for fuel contamination check	DBP1007523
Draeger gas detector tube, for use with toxic gas detector	CH254 KW2
Kerosene contamination comparison chart, for comparative colour layer check to determine contamination of oil by fuel.	E925162001

B. Prepare

WARNING: AN IDG WHICH HAS RECENTLY BEEN RUNNING MAY

CONTAIN HOT OIL UNDER PRESSURE.

(1) Vent the IDG case by pressing in the case pressure vent valve.

(2) Remove and inspect the magnetic drain plug for freedom from contamination (Ref. para.7.).

CAUTION: THE OIL SAMPLE BOTTLE AND SAMPLING NOZZLE MUST BE FREE FROM CONTAMINATION; ENSURE THAT THE PROTECTIVE SEALING ENCLOSING THESE ITEMS IS INTACT.

(3) Remove the protective sealing from the sampling nozzle and the 60 ml oil sample bottle. Remove and retain the bottle top and assemble the sampling nozzle to the bottle.

C. Take Oil Sample

(1) Using the sampling nozzle to lift the internal self-closing valve, drain oil from the magnetic drain plug orifice into the sample bottle until the bottle is approximately two-thirds full. Remove the sampling nozzle then assemble, seal and secure the bottle top.

(2) Ensure that two serviceable sealing rings are fitted to the magnetic drain plug, then refit the plug by pressing it in and rotating it clockwise. Ensure that the plug is correctly installed, by checking that the three indentations on the plug are coincident with those on the self-closing valve body.

(3) Close the case pressure vent valve by pulling it out to its full extent.

D. Prepare for Fuel Contamination Check

(1) Transfer the oil sample from the bottle to an open container.

(2) Remove the Draeger gas detector tube CH254 KW2 from its packet and, using the small metal ring on the gas detector assembly in the Draeger toxic gas detector kit, break off the ends of the tube.

(3) Insert the gas detector tube firmly into the gas detector assembly with the arrow marked on the tube pointing toward the assembly.

E. Check Oil Sample for Fuel Contamination

WARNING: DO NOT INHALE THE SMOKE THAT IS SEEN TO ISSUE FROM THE GAS DETECTOR ASSEMBLY AND TUBE WHEN PUMPING THE ASSEMBLY.

(1) Hold the gas detector assembly so that the open end of the gas detector tube is not more than 0.5 in above the surface of the sample, then squeeze and release the assembly ten times.

(2) Using the gas detector tube and kerosene contamination comparison chart, determine and record the percentage contamination of the oil by fuel.

NOTE: With zero contamination indication, slight discolouration may occur with new oil.

(3) Remove and discard the gas detector tube, then squeeze and release the gas detector assembly at least ten times to flush with clean air before storing.

(4) If there is no indication of fuel in the oil, i.e., if the percentage contamination determined in operation (2) is zero, proceed as follows:-

(a) Discard the oil sample.

(b) Check the IDG oil level (Ref. para.3.).

(5) If there is indication of fuel in the oil, i.e., if the percentage contamination determined in operation (2) is 1 per cent or above, proceed as follows:-

CAUTION: WITH INDICATION OF FUEL IN OIL, ANY FURTHER ENGINE RUNNING MUST BE AT THE DISCRETION OF THE SENIOR ENGINEER PRESENT.

NOTE: Fuel contamination of the IDG oil system indicates failure of the oil cooler.

(a) Discard the oil sample used in the check and drain off a further oil sample as detailed in paragraph C.

(b) Complete the appropriate proforma in triplicate, including the following data:-

(b1) Reason for provision of oil sample.

(b2) IDG Serial No. and Engine No.

(b3) Oil Batch/Barrel No.

(b4) Date when oil sample was taken from IDG.

(c) Enter the proforma Code No. on the sample bottle.

(d) Despatch the oil sample as detailed in the following para. F.

CAUTION: WHENEVER AN IDG IS REMOVED BECAUSE OF POSSIBLE FAILURE, THE OIL COOLER AND CONNECTING PIPES MUST NOT BE USED AGAIN UNTIL THEY HAVE BEEN DECONTAMINATED.

IF CLEARANCE IS GIVEN FOR FURTHER RUNNING OF THE ENGINE WITHOUT RENEWAL OF THE OIL COOLER, THE IDG MUST BE DISCONNECTED AS SOON AS THE ENGINE IS RUN UP TO SPEED. THE IDG MUST THEN BE RENEWED WHEN THE OIL COOLER IS RENEWED.

(6) Determine further action to be taken in accordance with the requirements of the senior engineer. If clearance is given for further running of the engine, refer to the CAUTION and disconnect the IDG (Ref. 24-11-00, Adjustment/Test). If further running of the engine without renewal of the oil cooler is forbidden, proceed as follows:

(a) Renew the IDG (Ref. Removal/Installation).

(b) Renew the oil cooler (Ref. 79-21-01).

R
R

R
R

R

F. Despatch Oil Sample

(1) Despatch the oil sample, together with the proforma and copies, to the appropriate authority for a laboratory check.

7. Magnetic Drain Plug - Inspection/Check (Ref. Fig. 601)

CAUTION: ENSURE THAT THE MAGNETIC DRAIN PLUG IS PROTECTED FROM EXTERNAL CONTAMINATION AND ISOLATED FROM FERROUS METAL AND OTHER MAGNETIC PLUGS.

A. Prepare

(1) Clean the area around the magnetic drain plug.

WARNING: AN IDG WHICH HAS RECENTLY BEEN RUNNING MAY CONTAIN HOT OIL UNDER PRESSURE.

(2) Remove the magnetic drain plug by pressing in, rotating counter-clockwise and gently withdrawing it, taking care to ensure that any debris adhering to the magnetic drain plug is not dislodged.

NOTE: The close fitting of the magnetic drain plug sealing rings may cause some resistance to be felt while the plug is being withdrawn.

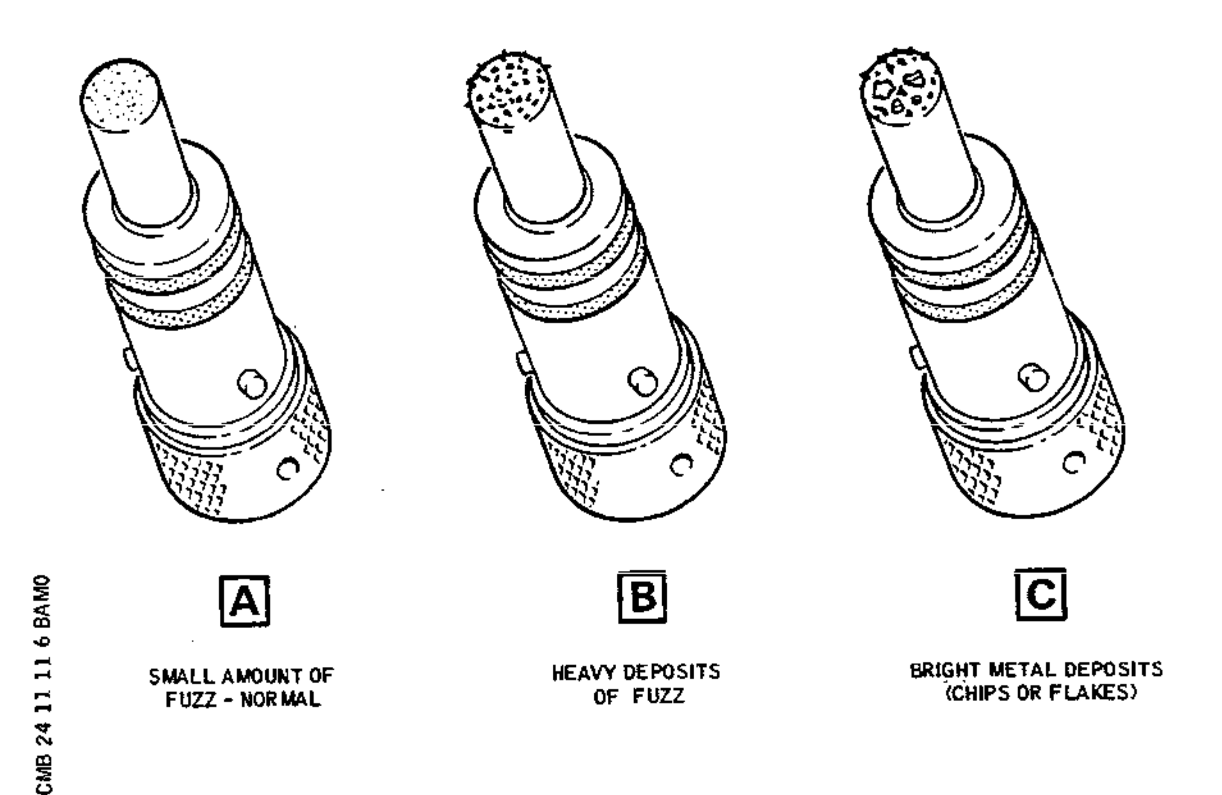
B. Inspect Magnetic Drain Plug

CAUTION: IF THE MAGNETIC DRAIN PLUG IS CONTAMINATED, ANY FURTHER RUNNING OF THE IDG MUST BE AT THE DISCRETION OF THE SENIOR ENGINEER PRESENT.

(1) Inspect the magnetic drain plug for signs of contamination. If the plug is free from contamination, i.e., there is no debris adhering to the plug, install the plug as detailed in the following para. E. If there is any debris

adhering to the plug, the plug must be checked for assessment of contamination and action required as detailed in the following paragraph D.

C. Assess Contamination and Action Required (Ref. Fig. 602)



Magnetic Drain Plug Condition
Figure 602

CAUTION: THE PERMISSION OF THE SENIOR ENGINEER MUST BE OBTAINED FOR ANY ACTION REQUIRED UNDER THE FOLLOWING PROCEDURES, INCLUDING ANY FURTHER RUNNING OF THE IDG. THESE PROCEDURES INVOLVE THE SUBMISSION OF DEBRIS FOUND ON THE MAGNETIC DRAIN PLUG TO A LABORATORY CHECK AND CARE MUST BE TAKEN TO ENSURE THAT ANY DEBRIS ADHERING TO THE PLUG IS NOT DISLODGED UNTIL REMOVAL IS REQUIRED BY THE APPLICABLE PROCEDURE.

WHENEVER AN IDG IS REMOVED BECAUSE OF POSSIBLE FAILURE, THE OIL COOLER AND CONNECTING PIPES MUST NOT BE USED AGAIN UNTIL THEY HAVE BEEN DECONTAMINATED.

(1) Inspect the debris adhering to the magnetic drain plug and carry out the applicable procedures as follows:-

(a) If a small amount of fine granular material is present, which is normal (Ref. Fig. 602) (Detail A), proceed as follows:-

a1) Process the plug for microscopic inspection of the debris as detailed in the following paragraph D.

a2) Install the plug as detailed in the following paragraph E.

(b) If heavy deposits of fuzz are present (Ref. Fig. 602) (Detail B), and if the transmission has been operating normally and both filter indicator buttons (charge oil filter and scavenge filter) are in the normal (retracted) position, proceed as follows:-

b1) Process the plug for microscopic inspection of the debris (Ref. para.D.).

b2) Install the plug (Ref. para.E.).

b3) Remove and inspect the magnetic drain plug after the next engine run. If there is an accumulation of fuzz equal to or greater than the original amount, indicating internal failure, process the plug for microscopic inspection of the debris (Ref. para.D.), re-install the magnetic drain plug, then renew the IDG (Ref. Removal/Installation).

(c) If heavy deposits of fuzz are present (Ref. Fig. 602) (Detail B), and if the transmission has been operating normally and either one or both filter buttons (charge oil filter and scavenge filter) are protruding, process the plug for microscopic inspection of the debris (Ref. para.D.), then remove the charge oil filter and scavenge filter elements (Ref. Removal/Installation), and examine both for evidence of non-magnetic chunks (deposits clearly definable as being caused by breakage, in contrast to non-magnetic flakes and slivers caused by normal transmission wear). If

chunks of metal (breakage) are found on the filter elements, re-install the filter elements and the magnetic drain plug, then renew the IDG (Ref. Removal/Installation). If the filters are free of chunks of metal, proceed as follows:-

c1) Renew the charge oil filter and scavenge filter elements (Ref. Removal/Installation).

c2) Install the plug (Ref. para.E.).

c3) Remove and inspect the magnetic drain plug after the next engine run. If there is an accumulation of fuzz equal to or greater than the original amount, indicating internal failure, process the plug for microscopic inspection of the debris, (Ref. para.D.), re-install the magnetic drain plug, then renew the IDG (Ref. Removal/Installation).

(d) If debris in the form of any bright metal deposits (chips or flakes) is found on the plug (Ref. Fig. 602) (Detail C), indicating internal failure, process the plug for microscopic inspection of the debris (Ref. para.D.), re-install the magnetic drain plug, then renew the IDG (Ref. Removal/Installation).

**ON A/C 001-001,

D. Process Magnetic Drain Plug for Microscopic Inspection of Debris

(1) Prepare

(a) Place a protective sleeve over the magnetic drain plug, ensuring that any adhering debris is not disturbed.

(b) Attach to the magnetic drain plug a label bearing the Serial No. of the IDG from which the plug was removed, the Engine No. and the date of plug removal.

(c) Place the magnetic drain plug in a clean container and submit for processing.

(d) Fit a suitable blank to the magnetic drain

plug orifice in the IDG.

(2) Process

(a) Remove the magnetic drain plug from the container and remove the protective sleeve from the plug, taking care not to disturb any of the adhering debris. Retain the protective sleeve.

(b) Record the details entered on the label attached to the magnetic drain plug.

(c) Carefully wash the magnetic drain plug in white spirit to remove oil, again ensuring that none of the debris is knocked off. Lay the plug on a paper towel to dry off.

(d) Push the end of the magnetic drain plug onto a strip of transparent adhesive tape to collect all the particles adhering to the plug. Any debris which may have become transferred to the protective sleeve is to be added to that on the adhesive tape.

(e) Complete the appropriate proforma in triplicate, including the following data:-

e1) The details recorded from the label on the magnetic drain plug.

e2) The requirement, i.e., for the particles removed from the plug to be submitted to a detailed microscopic examination.

(f) Place the adhesive tape and particles in a suitable container and despatch, together with the proforma and copies, to:

The Non-metallic Section,
Materials and Chemistry Test Laboratory,
British Aircraft Corporation,
Filton, Bristol, England.

(g) Inform the following of the action taken in operation (f), including the data contained in the proforma:-

Propulsion Technical Office,
No.8 D.O.,
British Aircraft Corporation,

(h) Place the protective plastic sleeve over the magnetic drain plug and place the plug in a container. Return the plug for assembly to the IDG.

**ON A/C 002-007,

D. Process Magnetic Drain Plug for Microscopic Inspection of Debris

(1) Prepare

(a) Place a protective sleeve over the magnetic drain plug, ensuring that any adhering debris is not disturbed.

(b) Attach to the magnetic drain plug a label bearing the Serial No. of the IDG from which the plug was removed, the Engine No. and the date of plug removal.

(c) Place the magnetic drain plug in a clean container and submit for processing.

(d) Fit a suitable blank to the magnetic drain plug orifice in the IDG.

(2) Process

(a) Remove the magnetic drain plug from the container and remove the protective sleeve from the plug, taking care not to disturb any of the adhering debris. Retain the protective sleeve.

(b) Record the details entered on the label attached to the magnetic drain plug.

(c) Carefully wash the magnetic drain plug in white spirit to remove oil, again ensuring that none of the debris is knocked off. Lay the plug on a paper towel to dry off.

(d) Push the end of the magnetic drain plug onto a strip of transparent adhesive tape to collect all the particles adhering to the plug. Any debris which may have become transferred to the protective sleeve is to be added to that on the adhesive tape.

(e) Complete the appropriate proforma in triplicate, including the following data:-

e1) The details recorded from the label on the magnetic drain plug.

e2) The requirement, i.e., for the particles removed from the plug to be submitted to a detailed microscopic examination.

(f) Place the adhesive tape and particles in a suitable container and despatch, together with the proforma and copies, to the appropriate authority for a laboratory check.

(g) Place the protective plastic sleeve over the magnetic drain plug and place the plug in a container. Return the plug for assembly to the IDG.

E. Install Magnetic Drain Plug

(1) Ensure that two serviceable sealing rings are fitted to the magnetic drain plug, then fit the plug to the IDG by pressing it in and rotating it clockwise. Ensure that the plug is correctly installed, by checking that the three indentations on the plug are coincident with those on the self-closing valve body.

(2) Check the IDG oil level (Ref. para.3.).

INTEGRATED DRIVE GENERATOR - APPROVED REPAIRS

1. General

(1) This topic contains the procedures necessary for the renewal of certain Screwlock wire thread inserts which are fitted in the casing or accessory fittings of an integrated drive generator (IDG). These procedures are applicable to the Screwlock inserts that engage the attaching bolts for the IDG accessory items listed as follows:-

(a) Pressure switch keep plate.

(b) Governor adjuster keep plate/locking plate.

(c) Charge filter cap.

(d) Scavenge filter cap.

(e) Differential pressure indicators at filter caps.

(f) Oil inlet temperature probe.

(g) Oil outlet temperature probe.

(2) The application of these Screwlock insert renewal procedures is permissible as a line maintenance operation subject to the approval of the senior engineer present. The renewal of some inserts may not be practicable without removal of the IDG from the aircraft. The procedures are applicable only under strictly controlled conditions, i.e., IDG equipment housings and oilways exposed by the removal of accessory fittings must be suitably protected to prevent any possibility of contamination, and access for tooling the affected Screwlock insert must be unobstructed.

(3) A Screwlock wire thread insert consists of wire of diamond section wound into a helical coil. One or more of the intermediate coils are polygonal and thus create pressure on the thread flanks of any screw or bolt screwed into the insert.

(4) A Screwlock insert is fitted to an oversize hole tapped with a special tap and when correctly fitted it has an internal thread which conforms to British Standard limits. One end of the wire is bent inward across the major axis of the coil to form a tang which provides a purchase for the inserting tool. The tang is notched to facilitate its breakage and removal after the insert

has been fitted.

2. Screwlock Wire Thread Insert Renewal

A. Equipment and Materials

DESCRIPTION	PART NO.
Hylomar Compound, Spec. SQ32L for application to a Screwlock insert prior to installation	-
Approved IDG operating oil, for lubrication of the bolt required for checking the inbuilt torque of a Screwlock insert after installation	-
Screwlock insert (6-32 UNC), for attachment bolts of differential pressure indicator at filter cap	3585-06CN345 (Armstrong Patents)
Screwlock insert (10-32 UNF), for pressure switch keep plate attachment bolts	3591-3CN-380 (Armstrong Patents)
Screwlock insert (10-32 UNF), for governor adjuster keep plate/locking plate attachment bolts	3591-3CN475 (Armstrong Patents)
Screwlock insert (1/4-28 UNF), for charge filter cap, scavenge filter cap and temperature probes attachment bolts	3591-4CNV5-8 (Armstrong Patents)
Torque spanner, 0 to 3.8 lbf in (0 to 0.043 mdaN), for checking the inbuilt locking torque of inserts of thread size 1/4-28 UNF	-
Torque spanner, 0 to 1.0 lbf in (0 to 0.011 mdaN), for checking the inbuilt locking torque of inserts of thread size 6-32 UNC	-
Torque spanner, 0 to 2.1 lbf in	-

DESCRIPTION	PART NO.
(0 to 0.024 mdaN), for checking the inbuilt locking torque of inserts of thread size 10-32 UNF	
Extraction tool, for inserts of thread size 6-32 UNC	1227-06 (Armstrong Patents)
Extraction tool, for inserts of thread sizes 10-32 UNF and 1/4-28 UNF	1227-6 (Armstrong Patents)
Plug tap, for inserts of thread size 6-32 UNC	06 CPB (Armstrong Patents)
Plug tap, for inserts of thread size 10-32 UNF	3 FPB (Armstrong Patents)
Plug tap, for inserts of thread size 1/4-28 UNF	4 FPB (Armstrong Patents)
Bottom tap, for inserts of thread size 6-32 UNC	06 CBB (Armstrong Patents)
Bottom tap, for inserts of thread size 10-32 UNF	3 FBB (Armstrong Patents)
Bottom tap, for inserts of thread size 1/4-28 UNF	4 FBB (Armstrong Patents)
Gauge (screw thread), for checking the tapped hole for inserts of thread size 6-32 UNC	1440-06 (Armstrong Patents)
Gauge (screw thread), for checking the tapped hole for inserts of thread size 10-32 UNF	1694-3 (Armstrong Patents)
Gauge (screw thread), for checking the tapped hole for inserts of thread size 1/4-28 UNF	1694-4 (Armstrong Patents)

DESCRIPTION	PART NO.
Inserting tool (pre-wind type) for inserts of thread size 6-32 UNC	3551-06 (Armstrong Patents)
Inserting tool (pre-wind type) for inserts of thread size 10-32 UNF	3552-3 (Armstrong Patents)
Inserting tool (pre-wind type) for inserts of thread size 1/4-28 UNF	3552-4 (Armstrong Patents)
Tang removal tool, for inserts of thread size 6-32 UNC	3580-06 (Armstrong Patents)
Tang removal tool, for inserts of thread size 10-32 UNF	3581-3 (Armstrong Patents)
Tang removal tool, for inserts of thread size 1/4-28 UNF	3581-4 (Armstrong Patents)

B. Prepare to Renew Insert

CAUTION: THE PERMISSION OF THE SENIOR ENGINEER MUST BE OBTAINED FOR ACTION REQUIRED UNDER THE FOLLOWING SCREWLOCK INSERT RENEWAL PROCEDURES.

GREAT CARE MUST BE TAKEN TO ENSURE THAT IDG EQUIPMENT HOUSINGS AND OILWAYS EXPOSED BY THE REMOVAL OF ACCESSORY FITTINGS ARE SUITABLY PROTECTED TO PREVENT ANY POSSIBILITY OF CONTAMINATION. IF CONTAMINATION IS EVIDENT OR SUSPECTED, THE IDG MUST BE RETURNED FOR INVESTIGATION. CHECK THE SITUATION OF THE AFFECTED SCREWLOCK INSERT; THE RENEWAL PROCEDURES MUST NOT BE COMMENCED WITH THE IDG IN SITU UNLESS ACCESS IS SUFFICIENT TO ENSURE SAFE APPLICATION AT ALL STAGES.

(1) Refer to the CAUTION. If necessary for safe application of the Screwlock insert renewal procedures, remove the IDG (Ref. Removal/

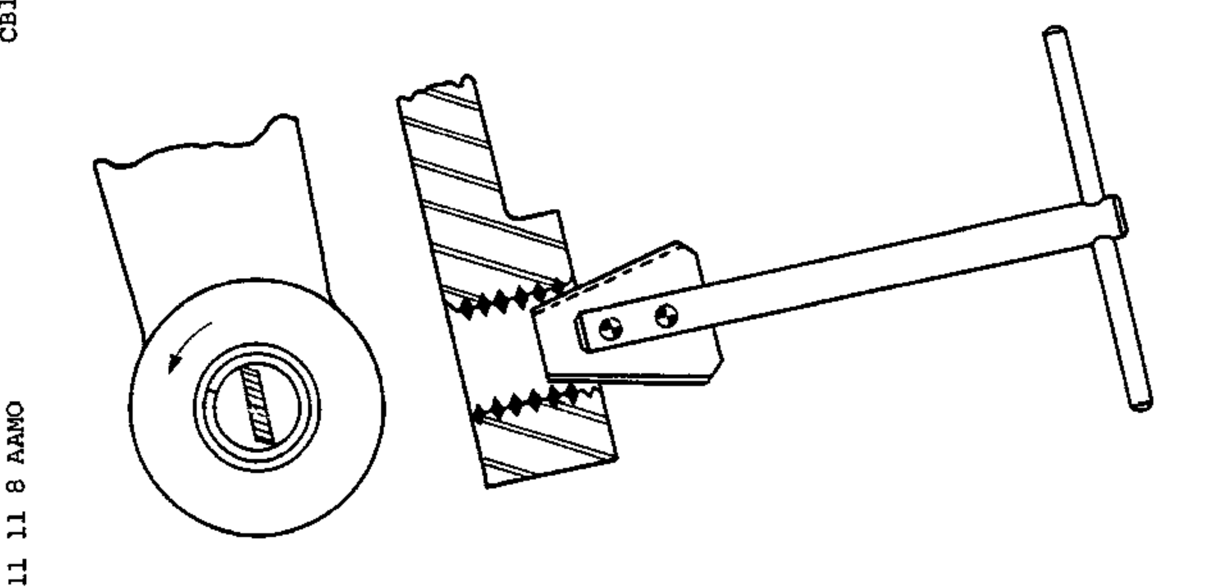
Installation).

(2) If not already removed, remove the affected accessory fittings as necessary for access to the Screwlock insert (Ref. Removal/Installation).

(3) Refer to the CAUTION. Use suitable blanking methods to ensure that IDG equipment housings and oilways, exposed by the removal of accessory fittings, are protected as necessary to prevent any possibility of contamination.

C. Remove Insert (Ref. Fig. 801)

CB15141/OOA



CMB 24 11 11 8 AAMO

- Extraction Tool for Screwlock Thread Insert
Figure 801

(1) Align the blade of the appropriate extraction tool approximately one quarter of a coil from the outer end of the insert (Ref. Fig. 801). Tap lightly to to obtain a 'bite' and wind the insert out in a a counter-clockwise direction. Thoroughly clean out the threaded hole with a compressed air blast. Discard the removed insert.

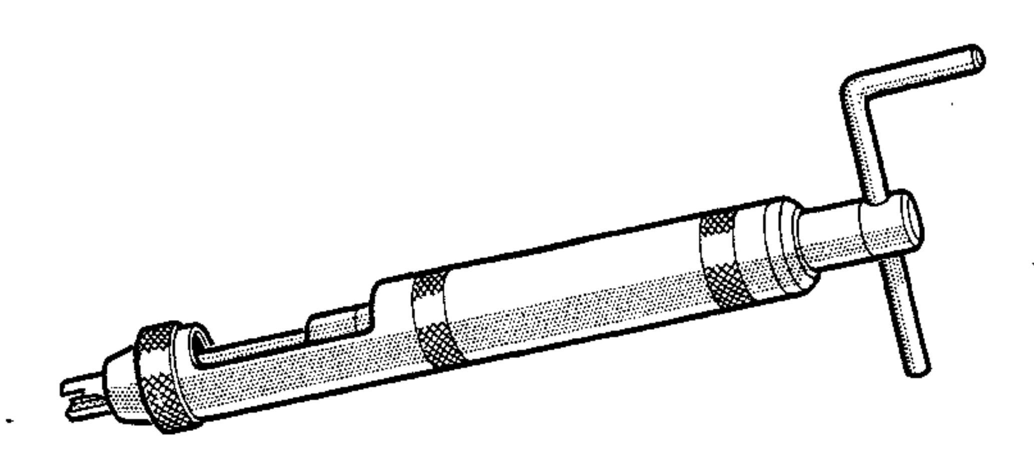
(2) Re-tap the hole, using the appropriate plug tap or bottom tap.

(3) Check the tapped hole, using the appropriate screw thread gauge.

NOTE: If the tapped hole is oversize with respect to the screw thread gauge limits, the hole must be repaired to an approved scheme.

D. Install Insert (Ref. Fig.802 and 803)

CB15142/OOA



CMB 24 11 11 8 BAMO

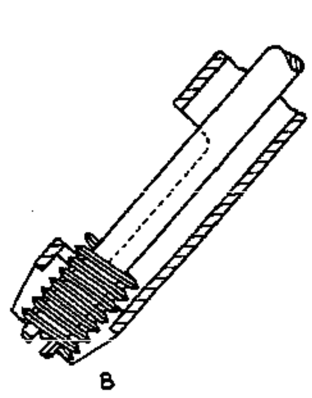
- Pre-wind Inserting Tool for Screwlock Thread Insert
Figure 802

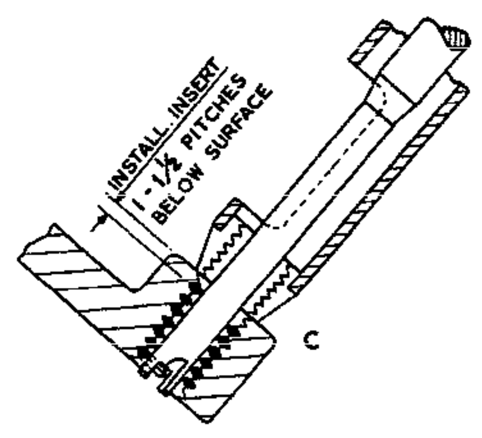
(1) Using the correct Screwlock insert and the appropriate pre-wind inserting tool (Ref. Fig. 802), withdraw the mandrel of the tool outward until the insert can be fitted into the tool chamber. Smear the tapped hole and the insert with Hylomar compound SQ32L. Place the insert in the chamber with the tang of the insert toward the nozzle of the tool (Ref. Fig. 803) (Detail A).

CB15143/OOA

TANG

A





CMB 24 11 11 8 CAMO

Application of Screwlock Thread Insert
Pre-wind Inserting Tool
Figure 803

R R (2) Push the mandrel forward through the insert to engage the tang of the insert in the slot end of the mandrel.

(3) Rotate the mandrel clockwise, pushing forward gently until the insert engages in the tool nozzle. Continue winding until the first coil of the insert is just about to emerge (Ref. Fig. 803) (Detail B).

(4) Place the loaded tool squarely over the tapped hole in the IDG casing or accessory fitting and wind the mandrel clockwise until the insert is completely transferred from the tool and the insert is 1 to 1 1/2 thread pitches below the surface of the casing or fitting (Ref. Fig. 803) (Detail C). Do not use forward pressure.

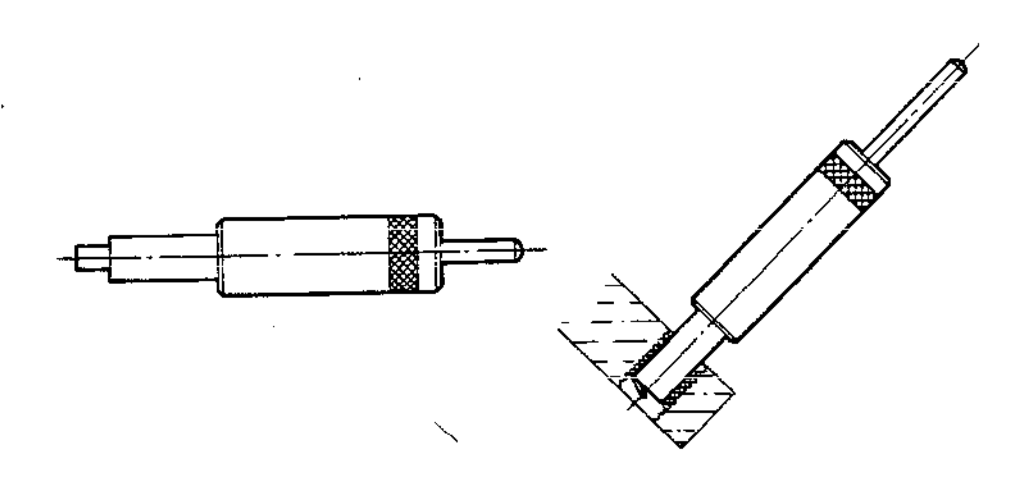
NOTE: Once the insert has left the tool nose, the depth of insert may be checked by pulling back the tool body slightly without disturbing the control mandrel.

(5) After the insert has been installed to the required depth, draw the mandrel straight out without any winding in either direction.

(6) Remove the tang immediately after installation of the insert as described under the following paragraph E.

E. Remove Tang from Insert after Installation (Ref. Fig. 804)

CB15144/OOA



CMB 24 11 11 8 DAMO

Application of Screwlock Thread Insert Tang Removal Tool
Figure 804

(1) Place the appropriate tang removal tool into the assembled insert and allow the tool to rest on the insert tang (Ref. Fig. 804). Strike the tool with a 6 to 8 oz (0.170 to 0.226 kg) hammer to detach the tang. Check that the tang has broken away cleanly and remove the freed tang.

F. Check Inbuilt Locking Torque of Insert after Installation

(1) Ensure that the tang has been removed from the insert.

(2) Using the correct size of bolt for the insert, check the inbuilt locking torque of the insert with the appropriate torque spanner. Smear the bolt with IDG operating oil and screw it down through the lock coils. Unscrew the bolt until free of the lock coils and check the inbuilt torque required to screw the bolt past the lock coils. The minimum inbuilt torque must be in accordance with Table 801.

THREAD SIZE OF INSERT	MINIMUM INBUILT LOCKING TORQUE
6-32 UNC	1.0 lbf in (0.011 mdaN)
10-32 UNF	2.1 lbf in (0.024 mdaN)
1/4-28 UNF	3.8 lbf in (0.043 mdaN)

Inbuilt Torque of Screwlock Thread Insert Locking Coils
Table 801

G. Conclusion

CAUTION: IF CONTAMINATION OF THE IDG IS EVIDENT OR SUSPECTED, THE IDG MUST BE RETURNED FOR INVESTIGATION.

(1) Refer to the CAUTION. Remove all blanking used to protect the IDG equipment housings and oilways during the Screwlock insert renewal procedures.

(2) Refit the IDG and/or accessory fittings as required (Ref. Removal/Installation).

LOAD CONTROLLER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Nos.1, 2, 3 and 4 load controllers are mounted in the flight compartment racking on shelves 2-215, 1-215, 1-216 and 2-216 respectively. Each load controller is contained within a rack-mounting case forming a single Elfin box (module) which is in turn installed in an Elfin housing case mounted on the appropriate shelf. The box is secured in the case by two securing screws at the front, and electrical connections are made through an electrical connector at the rear. A handle on the front of the load controller facilitates removal and installation of the module.

The following removal and installation procedures apply to any one of the four load controllers.

2. Load Controller

CAUTION: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/INSTALLATION PROCEDURES.

A. Prepare

(1) Gain access to the load controller by removing the appropriate panel from the flight compartment racking.

B. Remove

(1) Release the two securing screws and withdraw the load controller from the Elfin case.

RB (2) Examine rack and unit connectors for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket
RB contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts
RB and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

C. Install

(1) Comply with the electrical safety precautions.

RB (2) Examine unit connector for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket
RB contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising
RB posts and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

(3) Place the load controller in its housing in the Elfin case and slide it back until the electrical connector is fully engaged with the mating connector at the back of the case, ensuring that the unit is bonded in accordance with 20-27-11.

(4) Secure the load controller to the Elfin case with the two securing screws.

D. Conclusion

(1) Refit and secure the panel to the racking.

(2) Carry out a System Test with main engines running (Ref. 24-21-00, Adjustment/Test, para.2.E. System Test - Final - Main Engines Running).

END OF THIS SECTION

NEXT

EMERGENCY GENERATOR DRIVE - DESCRIPTION AND OPERATION

1. General (Ref. Fig.001 and 002)

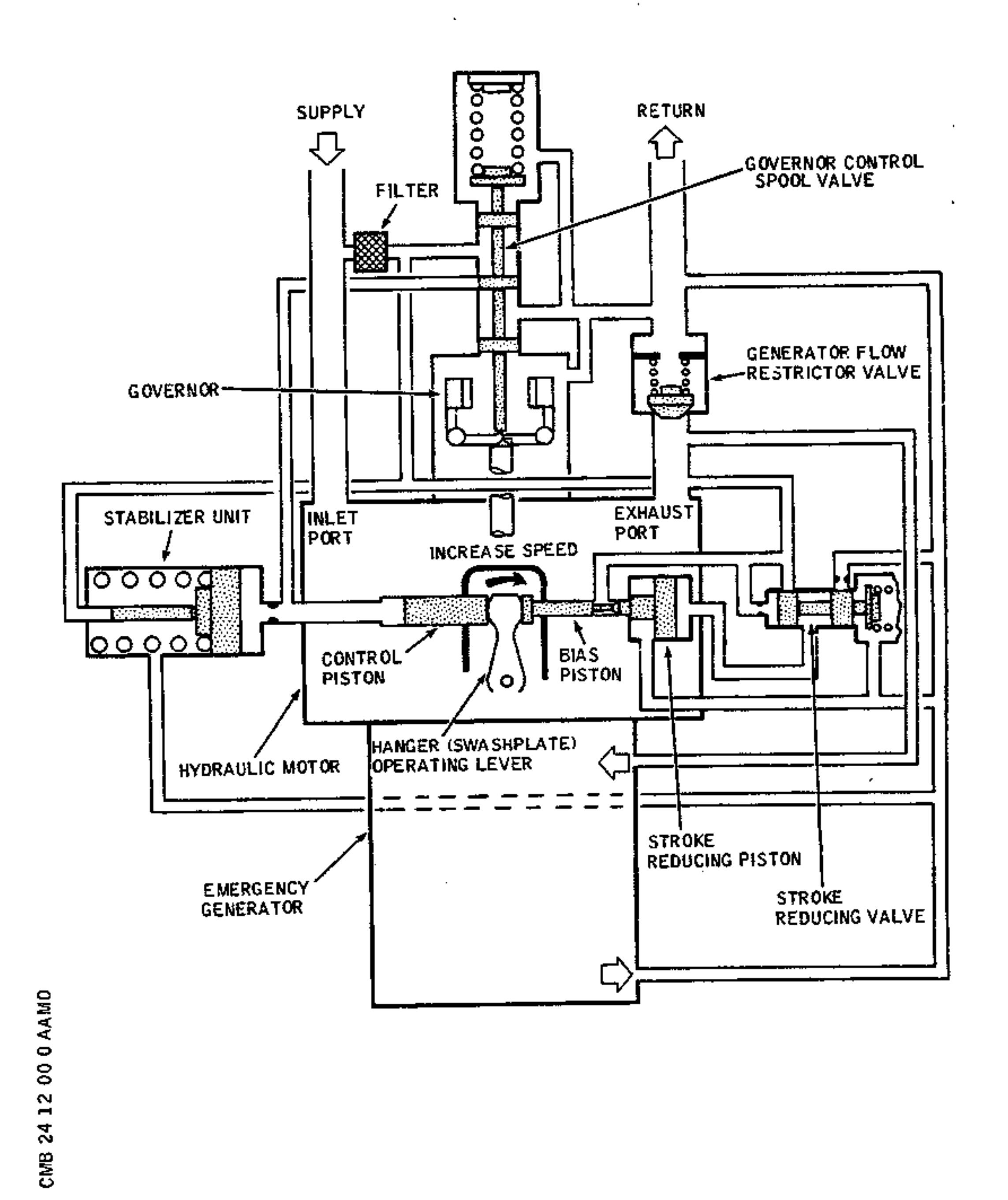
The emergency a.c. generator, which is rated at 30 kVA 200/115 V 400 Hz, is driven by a servo-controlled hydraulic motor. The hydraulic motor is stabilized to provide a constant output speed of 8,000 rpm under conditions of changing load and variations of hydraulic pressure so that the generator frequency of 400 Hz is maintained within close limits.

The motor and generator, together with the hydraulic components that control and stabilize the motor output, form an integral unit which is attached directly to the aircraft structure below the floor of the rear baggage compartment.

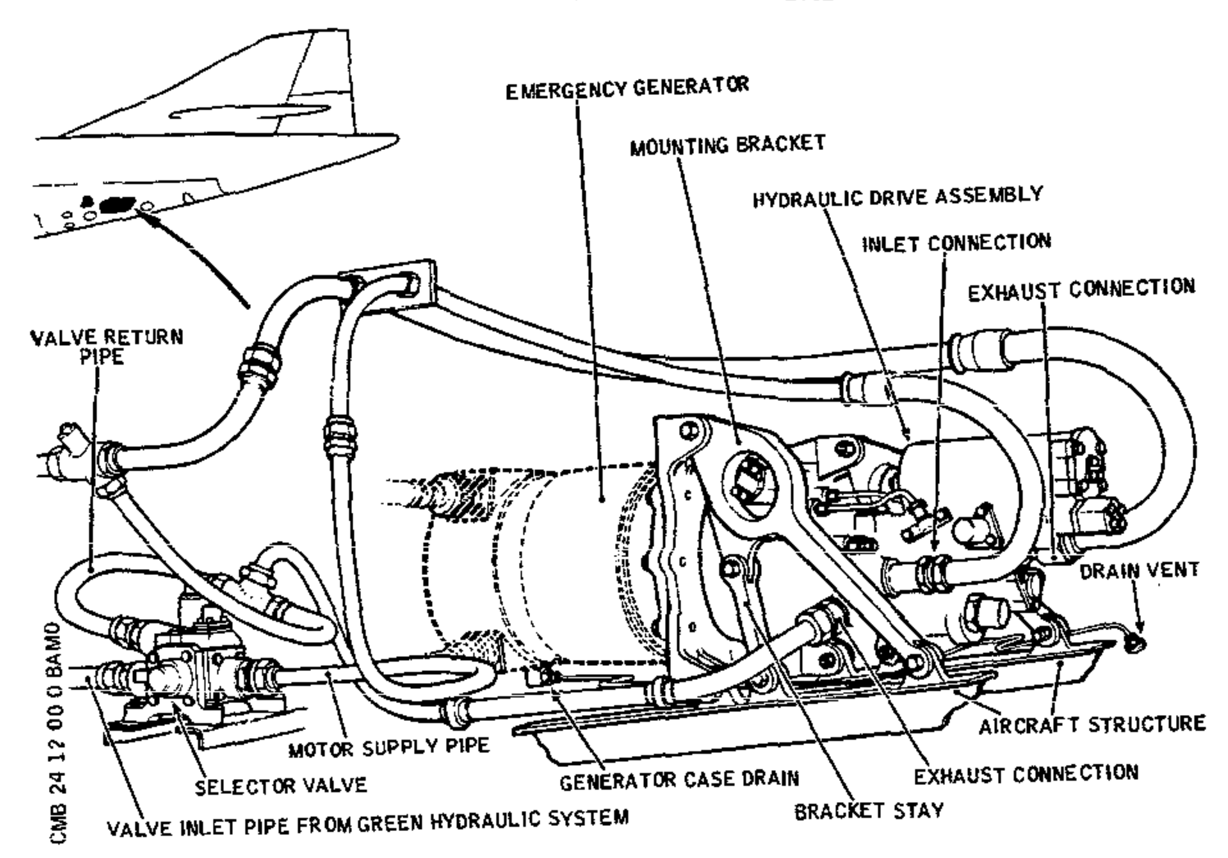
Power for the hydraulic motor is supplied by the green hydraulic system. Connection of the power supply to the hydraulic motor is effected by a solenoid-operated selector valve incorporated in the control circuits of the emergency a.c. generation system (Ref. 24-22-00). A continuous flow of hydraulic fluid ducted through the generator rotor and stator windings and the main shaft bearings provides cooling and lubrication of the emergency generator. Two sensing elements are fitted in the unit, one at the generator bearing and one at the stator housing. These sensing elements are connected into an overheat warning circuit (Ref. 24-22-00). The generator and drive case drains are connected to a common drain vent in the fuselage bottom skin.

2. Hydraulic Motor (Ref. Fig. 002)

The hydraulic motor unit comprises a rotating cylinder block housing nine pistons which act against a variable angle hanger (swashplate), a mechanical governor assembly, a stroke limiter assembly and a hydraulic stabilizer unit. The angle at which the hanger is inclined governs the stroke of the pistons, and so controls the displacement of the motor and the torque that it will produce from a given supply. A bob-weight governor, driven by a quill shaft connected to the main drive-shaft, controls the movement of the governor control spool valve, which regulates the flow of pressurized fluid to the stabilizer unit and the control piston acting on the hanger operating lever. A bias piston within the hanger operating mechanism, which is damped by the action of the stabilizer unit, opposes the action of the control piston to provide a substantially constant bias force to the hanger movement.



- Emergency Generator Drive - Schematic Diagram
Figure 001



\- Emergency Generator Hydraulic Drive
Figure 002

3. Selector Valve (Ref. Fig. 002)

The selector valve is bolted to a mounting bracket immediately forward of the emergency generator drive and is supplied with pressurized fluid from the green hydraulic system. When the valve solenoid is de-energized the motor supply port is closed and the supply fluid is directed to the system return line. When the selector valve solenoid is energized the return port is closed and the pressurized fluid is directed to the hydraulic motor.

4. Operation

A. Control and Indication

The emergency generator is brought into operation by the opening of the solenoid valve, i.e., when the solenoid is energized. A complete description of emergency generation control and indication is given in 24-22-00.

B. Functional Description (Ref. Fig. 001)

When the emergency generator has been brought into operation by the energizing of the solenoid valve (Ref. 24-22-00) the generator is automatically maintained at a constant operating speed of 8,000 rpm by the internal control mechanism of the hydraulic motor.

Variations in generator loading or hydraulic fluid supply which reduce the motor speed are sensed by the mechanical governor. The governor control spool valve adopts a position to increase the hydraulic pressure on the control piston, which acts on the hanger operating lever. The hanger, moved to a coarser angle by the hanger lever, lengthens the stroke of the pistons, causing an increase in torque and raising the speed of the motor to the governor setting.

The control piston is opposed by a bias piston which is damped by the action of a stabilizer unit and constantly endeavours to decrease the angle of the hanger assembly. When the motor output torque has increased the speed to normal, a balance state will exist across the control piston and bias piston to maintain a constant speed.

When the emergency generator is being started, or the hydraulic supply to the motor is below normal system working pressure, a stroke reducing valve becomes operative and directs hydraulic supply pressure to a stroke reducing piston. This piston is forced against a stop and by overriding the bias piston reduces the hanger angle to prevent the hydraulic motor from overloading the hydraulic system. When minimum working differential pressure across the motor is attained the stroke reducing piston and the unit resume normal operation.

A restrictor valve situated in the hydraulic motor outlet develops a back pressure necessary to direct a cooling flow of hydraulic fluid through the generator.

EMERGENCY GENERATOR AND DRIVE UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

OBSERVE THE HYDRAULIC FLUID PRECAUTIONS DETAILED IN 29-00-00.

1. General

The emergency a.c. generator and the hydraulic drive are assembled, installed, tested, and removed as a single integral unit. The combined unit is installed on a mounting assembly located below the floor of the rear baggage compartment.

2. Emergency Generator and Drive Unit (Ref. Fig.401 and 402)

A. Equipment and Materials

DESCRIPTION	PART NO.
Handling equipment, emergency generator	E935052000
Circuit breaker safety clips	-
Pressure blank, for hydraulic exhaust connector adapter on the generator drive unit	AN929-16
Pressure blank, for hydraulic inlet connector adapter on the generator drive unit	NSA8817-12
Pressure blank assembly, for hydraulic motor case drain adapter on the generator drive unit	AN929-12
Torque spanner, 30 to 40 lbf in (0.339 to 0.452 mdaN)	-
Torque spanner, 60 to 70 lbf in (0.678 to 0.791 mdaN)	-
Torque spanner, 80 to 90 lbf in (0.904 to 1.017 mdaN)	-
Torque spanner, 445 to 455 lbf in	-

DESCRIPTION	PART NO.
(5.026 to 5.141 mdaN)	
Torque spanner, 645 to 655 lbf in (7.288 to 7.401 mdaN)	-
Torque spanner, 855 to 945 lbf in (9.661 to 10.678 mdaN)	-
Torque spanner, 1,030 to 1,050 lbf in (11.639 to 11.865 mdaN)	-
Torque spanner, 1,140 to 1,240 lbf in (12.882 to 14.204 mdaN)	-
R R Hydraulic fluid, (Ref. 20-30-00, No.11)	-

B. Prepare

WARNING: THE GREEN HYDRAULIC SYSTEM MUST NOT BE PRESSURIZED DURING THE FOLLOWING REMOVAL/ INSTALLATION PROCEDURES.

(1) Depressurize the green hydraulic system (Ref. 29-00-00).

(2) Check that the emergency generator mode switch is at AUTO.

(3) Electrically isolate the emergency generator and drive unit by tripping all the circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
EMERG SUPPLY No.1 ESS	23-215	1X121	-
EMERG SUPPLY No.2 ESS	23-215	2X121	-
EMERG SUPPLY	23-215	3X121	-

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
No.3 ESS			
EMERG SUPPLY No.4 ESS	23-215	4X121	-
EMERG POWER VOLTS/FREQ IND	23-215	1X227	-
RELIGHT BAR 2 & 3 EMERG SUPPLY	23-215	3X227	-
No.2 & 3 EMERG RELT BUS SELECT SUP	1-213	1X230	R10
EMERG GEN MANL CONT	1-213	X211	R9
EMERG GEN AUTO CONT	3-213	X212	G10

(4) Gain access to the emergency generator and drive unit by opening access doors 153 DB and 153 EB (Ref. 52-41-41).

(5) Remove the scavenge tank overflow pipe obstructing the access door aperture (153 DB) (Ref. 28-12-52).

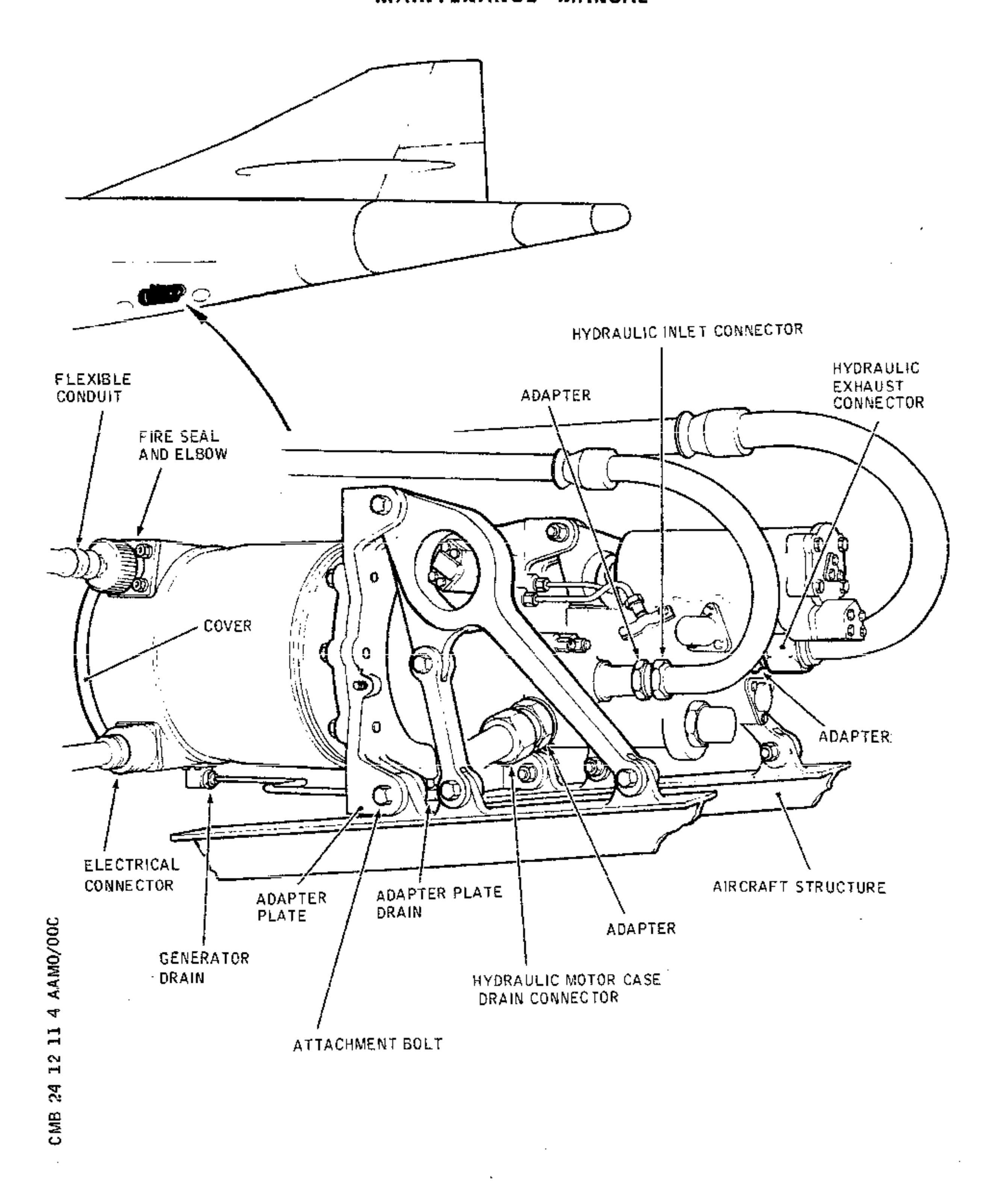
(6) Remove the bolts and washers securing the cover to the front of the emergency generator and remove the cover to gain access to the electrical terminal enclosure.

(7) Disconnect the electrical cables from the emergency generator terminals (A, B, C and N).

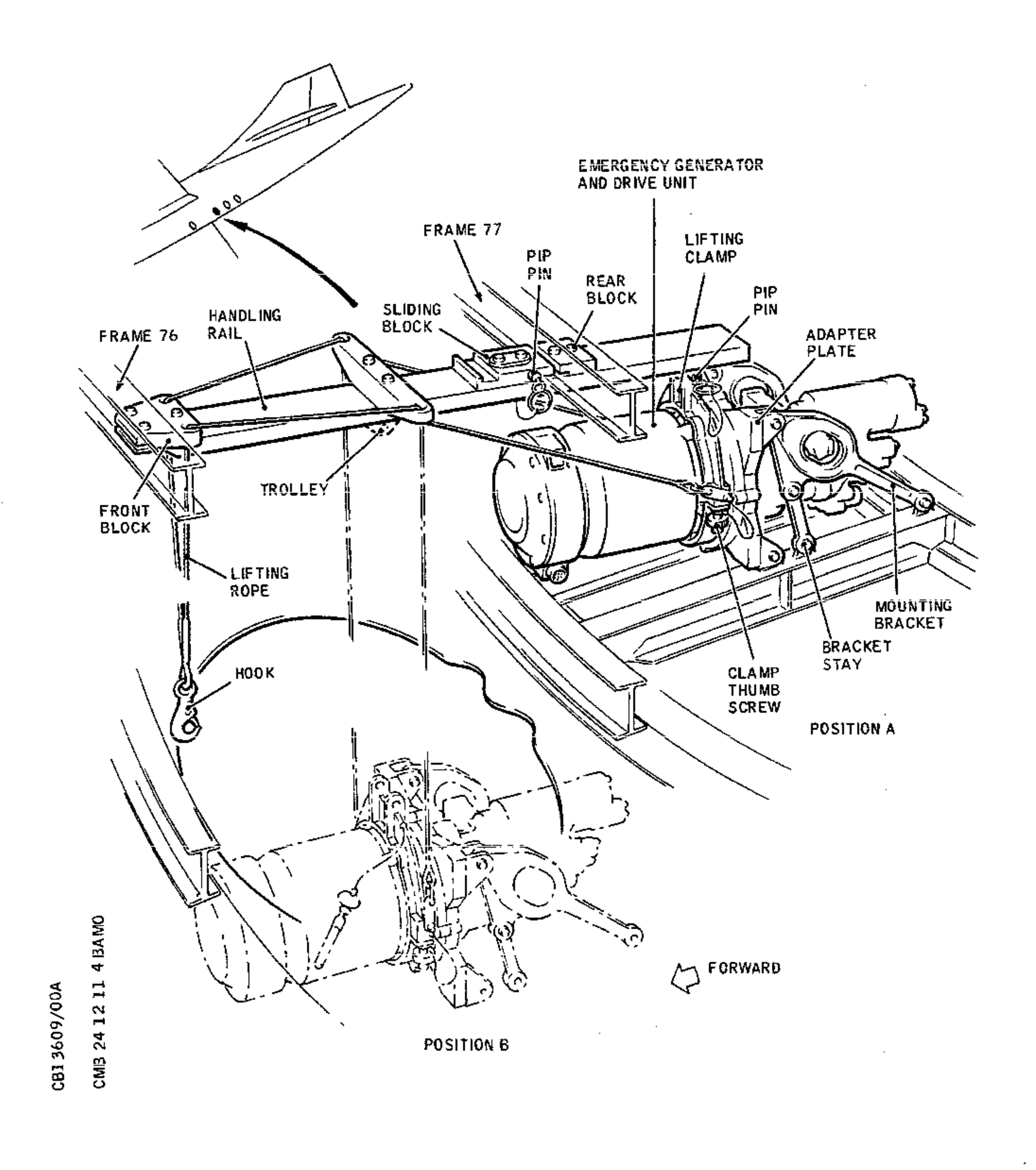
(8) Remove the bolts and washers securing the elbow assembly over the aperture in the terminal enclosure and withdraw the four electrical cables complete with elbow, fire seal and flexible conduit.

(9) Disconnect the electrical connector from the emergency generator.

(10) Refit the cover removed in operation (6) and blank



- Emergency Generator and Drive Unit - Installation
Figure 401



\- Emergency Generator and Drive Unit Handling Equipment - Installation
Figure 402

off the aperture in the terminal enclosure.

(11) Place the sliding block on the handling rail in the forward position.

(12) Position the handling rail along the centre line of the aircraft between frames 76 and 77; slide the rail forward to engage the front block with frame 76 and the rear block with the aft side of frame 77. Move the sliding block aft to engage with the front of frame 77 and lock it in position with the Pip pin.

(13) Secure the lifting clamp around the generator and drive unit (Ref. Fig. 402) (position A).

(14) Position the trolley over the lifting clamp.

C. Remove

CAUTION: HYDRAULIC FLUID WILL ESCAPE DURING DISCONNECTION OF PIPING FROM THE DRIVE UNIT.

(1) Place protective sheeting beneath the emergency generator and drive unit, suitably arranged to catch escaping hydraulic fluid, and make available a plastic bag to catch escaping fluid from the connecting pipes.

(2) Disconnect the drain pipe connectors from the generator drain and the adapter plate drain ports. Fit suitable blanks to the drain ports and the associated drain pipe connectors in accordance with 20-23-11.

(3) Disconnect the hydraulic exhaust connector from the adapter on the generator drive unit. Blank off the adapter with the pressure blank in accordance with 20-23-11 and torque-tighten it to between 1,140 and 1,240 lbf in (12.882 and 14.204 mdaN).

(4) Fit the appropriate blank to the hydraulic exhaust flexible pipe connector in accordance with 20-23-11 and torque-tighten it to between 1,140 and 1,240 lbf in (12.882 and 14.204 mdaN).

(5) Disconnect the hydraulic inlet connector from the adapter on the generator drive unit. Blank off the adapter with the pressure blank in accordance with 20-23-11 and torque-tighten it to between 855 and 945 lbf in (9.661 and 10.678

mdaN).

(6) Fit the appropriate blank to the hydraulic inlet flexible pipe connector in accordance with 20-23-11 and torque-tighten it to between 855 and 945 lbf in (9.661 and 10.678 mdaN).

(7) Disconnect the hydraulic motor case drain connector from the generator drive unit. Blank off the adapter with the pressure blank in accordance with 20-23-11 and torque-tighten it to between 855 and 945 lbf in (9.661 and 10.678 mdaN).

(8) Fit the appropriate blank to the hydraulic motor case drain flexible pipe connector in accordance with 20-23-11 and torque-tighten it to between 855 and 945 lbf in (9.661 and 10.678 mdaN).

R (9) Support the forward end of the generator by hand and remove the two lower adapter plate attachment bolts. Loosen the attachment bolts securing the mounting brackets and bracket stays to the attachment lugs on the aircraft structure. Secure the lifting clamp to the trolley assembly with the Pip pin, moving the generator fractionally up or down as necessary to facilitate insertion of the pin.

R WARNING: THE COMBINED GENERATOR AND DRIVE UNIT
R WEIGHS APPROXIMATELY 80 lb (36.287 kg).
R ADEQUATE PRECAUTIONS MUST BE TAKEN TO
R SUPPORT THE ASSEMBLY DURING REMOVAL AND
R INSTALLATION.

R (10) Remove the attachment bolts securing the mounting brackets and bracket stays to the aircraft structure.

R (11) Move the generator and drive unit forward on the trolley until it is positioned above the centre of the access door aperture (153 DB).

R (12) Attach a suitable counterbalance weight to the lifting rope hook.

R (13) Hold the lifting ropes together at the hook and release the lifting clamp assembly from the trolley by removing the securing Pip pin.

R (14) Carefully lower the generator and drive unit on the lifting rope; at the same time slowly rotate the unit to the vertical position (generator end down) to enable it to pass through the access door aperture.

R (15) Place the generator and drive unit on a suitable support, remove the counterbalance weight from the lifting rope hook and remove the lifting clamp from the generator.

R (16) Remove the bolts securing the mounting brackets to the generator and drive unit adapter plate.

R (17) Remove the adapters from the generator and drive unit inlet, exhaust and motor case drain ports and retain the adapters complete with the pressure blanks.

R (18) Fit a suitable blank to the generator and drive unit motor case drain port.

R (19) Turn the emergency generator and drive unit on end (generator downward) and charge the drive unit (motor body), to approximately 90 per cent capacity, with the specified hydraulic fluid, through the inlet port. Fit suitable blanks to the inlet and exhaust ports.

D. Install

CAUTION: THE DRIVE UNIT (MOTOR BODY) IS FILLED TO 90 PER CENT CAPACITY WITH HYDRAULIC FLUID

(1) Comply with the electrical and hydraulic safety precautions.

(2) Ensure that the handling equipment is correctly installed ready for installation of the unit (Ref. Fig. 402).

(3) Fit the adapter and O-ring seal, complete with pressure blank, to the generator and drive unit hydraulic inlet port in accordance with 20-23-11. Torque-tighten the adapter to between 645 and 655 lbf in (7.288 and 7.401 mdaN).

(4) Fit the adapter and O-ring seal, complete with pressure blank, to the generator and drive unit hydraulic exhaust port in accordance with 20-23-11. Torque-tighten the adapter to between

1,030 and 1,050 lbf in (11.639 and 11.865 mdaN).

(5) Fit the adapter and O-ring seal, complete with pressure blank, to the generator and drive unit motor case drain port in accordance with 20-23-11. Torque-tighten the adapter to between 445 and 455 lbf in (5.026 and 5.141 mdaN).

(6) Fit the mounting brackets, complete with bracket stays, to the generator and drive unit adapter plate, with the attachment nuts and bolts loosely assembled.

(7) Position the generator and drive unit below the access door (153 DB) and secure the lifting clamp around the generator case (Ref. Fig. 402) (position B).

(8) Attach a suitable counterbalance weight to the lifting rope hook, raise the unit, tilt the generator end downward and guide the generator and drive unit through the access door aperture.

(9) Continue to raise the unit until the hole on the lifting clamp assembly is in line with the hole in the trolley assembly and fit the Pip pin.

(10) Detach the counterbalance weight and move the generator and drive unit along the handling rail until the unit is positioned above the mounting lugs attached to the aircraft structure (Ref. Fig. 402) (position A).

(11) Tilt the emergency generator and drive unit to align the attachment holes in the mounting brackets and bracket stays with the associated holes in the mounting lugs attached to the aircraft structure. Fit and loosely assemble the securing nuts and bolts.

(12) Support the forward end of the generator by hand, remove the Pip pin to release the lifting clamp from the trolley assembly, align the adapter plate attachment holes with the associated holes in the mounting lugs and fit the securing nuts and bolts.

(13) Torque-tighten the nuts securing the adapter plate to the mounting brackets and mounting lugs to between 60 and 70 lbf in (0.678 and 0.791 mdaN) and lock the nuts with split pins.

(14) Torque-tighten the nuts on the mounting brackets and bracket stay attachment bolts to between 30 and 40 lbf in (0.339 and 0.452 mdaN) and lock them with split pins.

(15) Remove the emergency generator and drive unit handling equipment.

R (16) Remove the cover from the front of the generator and the protective cover from the aperture in the terminal enclosure.

R (17) Insert the four main electrical cables through the aperture in the terminal enclosure.

R (18) Connect the electrical cables to the terminals, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

R (19) Torque-tighten the nuts and terminals A, B and C to between 80 and 90 lbf in (0.904 and 1.017 mdaN) and torque-tighten the nut on terminal N to between 50 and 55 lbf in (0.565 and 0.621 mdaN).

R (20) Fit the fire seal, elbow and flexible conduit to the aperture in the terminal enclosure with the washers and bolts.

R (21) Refit the cover over the terminal enclosure on the front of the generator with the washers and bolts.

R (22) Connect the electrical connector to the generator, ensuring that the mating surfaces are clean and undamaged.

R (23) Place protective sheeting beneath the emergency generator and drive unit, suitably arranged to catch escaping hydraulic fluid.

R (24) Remove the blanks from the generator drain port and the adapter plate drain port and connect the drain vent pipe connectors to each drain port in accordance with 20-23-11. Torque-tighten the
R connectors to between 40 and 50 lbf in (0.452
R and 0.565 mdaN).

R (25) Remove the blanks from the hydraulic exhaust adapter and pipe connector and fit the exhaust connector to the adapter in accordance with 20-23-11. Torque-tighten the connector to between 1,140 and 1,240 lbf in (12.882 and 14.204 mdaN).

R (26) Remove the blanks from the motor case drain adapter and pipe connector and fit the motor case drain pipe connector to the adapter in accordance with 20-23-11. Torque-tighten the connector to between 855 and 945 lbf in (9.661 and 10.678 mdaN).

R (27) Remove the blanks from the hydraulic inlet adapter and pipe connector and fit the inlet pipe connector to the adapter in accordance with 20-23-11. Torque-tighten the connector to between 855 and 945 lbf in (9.661 and 10.678 mdaN).

E. Conclusion

(1) Remove the safety clips and reset the circuit breakers tripped before removal.

(2) Fit the scavenge tank overflow pipe removed to gain access (Ref. 28-12-52).

(3) Replenish and charge the green hydraulic system in accordance with the system requirement (Ref. 12-12-29).

(4) Refit access panels 153 DB and 153 EB (Ref. 52-41-41).

(5) Carry out an Operational Test of the system (Ref. Adjustment/Test).

EMERGENCY GENERATOR AND DRIVE UNIT - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

OBSERVE THE HYDRAULIC SAFETY PRECAUTIONS DETAILED IN 29-11-00.

1. General

The following Operational Test is primarily intended to check the emergency generator and drive unit after installation to confirm that it is operating correctly in the system. Functional and System Tests are not considered necessary in this application.

2. Operational Test

A. Prepare

(1) Make available electrical ground power as detailed in 24-00-00.

(2) Connect and supply hydraulic ground power to the green hydraulic system (Ref. 29-11-00, Servicing).

(3) Set the BATT A and BATT B control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line. Check also that the d.c. essential/main split magnetic indicators display in-line.

(4) Ensure that the EMERG RELIGHT BUSBAR selector switch on the engine starting panel (18-214) is set to OFF.

(5) Ensure that the emergency generator mode switch is set to AUTO.

B. Test

(1) Set the AC FREQ/VOLTS selector switch on the electrical generating control panel to "EMERG PWR".

(2) Set Nos.1 and 2 essential/main NORM/EMERG control switches to "EMERG" and check that the Nos.1 and 2 AC ESS BUS captions are illuminated.

(3) Set the emergency generator mode switch to "MANUAL" and check that -

(a) the emergency generator commences running, by

observing the voltage and frequency indications, approximately 115 V 400 Hz, on the associated meters,

(b) the EM GEN SELECTED caption is illuminated,

(c) the emergency generator FAIL caption is extinguished,

(d) the EM GEN O/HT caption is extinguished,

(e) Nos.1 and 2 AC ESS BUS captions are extinguished,

(f) an emergency generator load is indicated on the emergency generator KVA meter and

(g) the emergency generator voltage and frequency indications are not fluctuating.

(4) Set Nos.1 and 2 essential/main NORM/EMERG control switches to "NORM" and check that the No.1 and 2 AC ESS BUS captions are extinguished.

(5) Set the emergency generator mode switch to "AUTO" and check that the emergency generator ceases running, by observing that the voltage and frequency indications fall to zero.

C. Conclusion

(1) Check for leakage of hydraulic fluid at the hydraulic connections disturbed during removal of the emergency generator and drive unit.

(2) Switch off and disconnect the hydraulic ground power (Ref. 29-11-00).

(3) Set the BATT A and BATT B control switches to "OFF".

(4) Switch off and disconnect electrical ground power as detailed in 24-41-00.

SELECTOR VALVE - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

OBSERVE THE HYDRAULIC FLUID PRECAUTIONS DETAILED IN CHAPTER 29.

1. General

This is a solenoid-operated valve positioned in the hydraulic pipe line between the emergency generator drive and the green hydraulic system. The valve is fitted between stringers 33 and 35 on the left-hand side of the fuselage access panel forward of frame 77.

2. Selector Valve (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 70 to 80 lbf in (0.791 to 0.904 mdaN)	-
Torque spanner, 500 to 820 lbf in (5.65 to 9.266 mdaN)	-
Torque spanner, 645 to 655 lbf in (7.288 to 7.401 mdaN)	-

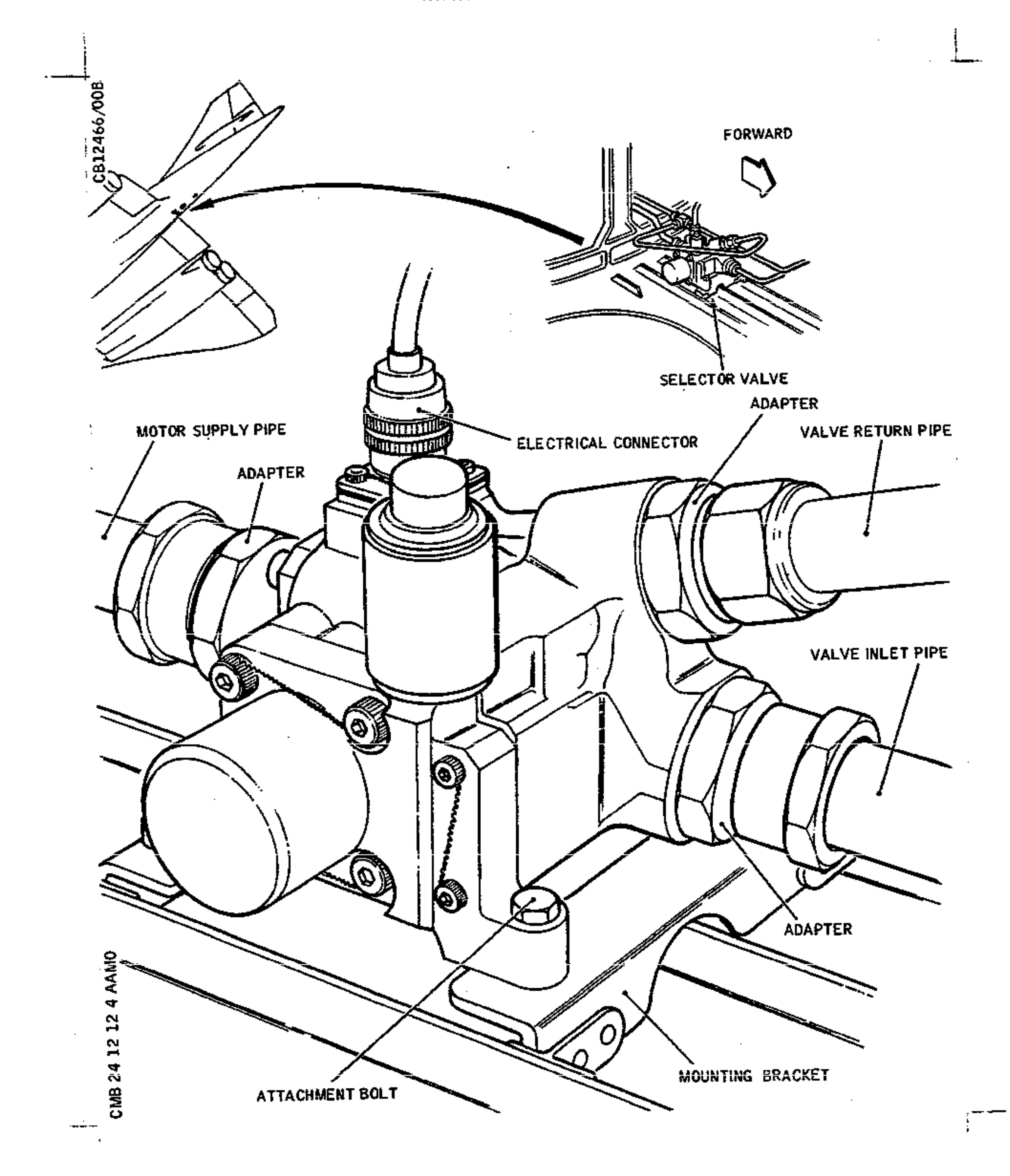
(1) Check that the emergency generator mode switch is at AUTO.

B. Prepare

(2) Trip the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9, and the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Fit safety clips to the tripped circuit breakers.

(3) Release the pressure in the green hydraulic system supply to the selector valve (Ref. Chap.29).

(4) Gain access to the valve by opening access door



- Selector Valve - Installation
Figure 401

R

153-DB (Ref. 52-41-41).

R (5) Make provision for collecting hydraulic fluid which will drain from the valve and pipes.

C. Remove

(1) Disconnect the electrical connector from the valve.

R (2) From the adapters on the valve, disconnect the motor supply, valve return and valve inlet pipe union nuts. Fit a suitable blank to each adapter, in accordance with 20-23-11.

R (3) Fit a suitable blank to each pipe union nut, in accordance with 20-23-11.

R (4) If the selector valve is to be removed, remove the adapters from the motor supply, valve return and valve inlet ports and retain the adapters complete with the blanks. Fit a suitable blank to each port, in accordance with 20-23-11.

R (5) Remove and retain the bolts securing the valve to the mounting bracket and remove the valve.

D. Install

(1) Comply with the electrical and hydraulic safety precautions.

R (2) Ensure that the valve has been prepared for installation in accordance with the following procedure:-

R (a) Fit the applicable adapter and a new O-ring seal, together with the blank, to the motor supply port, valve return port and valve inlet port, in accordance with 20-23-11.

R (b) Torque-tighten each adapter to between 645 and 655 lbf in (7.288 and 7.401 mdaN), in accordance with 20-23-12.

R (3) Position the valve in the aircraft and secure it to the mounting brackets with the bolts. Ensure that the unit is bonded in accordance with 20-27-11. Torque-load the mounting bolts to between 70 and 80 lbf in (0.791 and 0.904 mdaN).

R (4) Remove the blanks from the pipes and adapters, and

fit the valve inlet, valve return and motor supply pipes, commencing with the valve inlet pipe, in accordance with 20-23-11. Torque-tighten the pipe
R union nuts to between 500 and 820 lbf in (5.65 and
R 9.26 mdaN), in accordance with 20-23-12.

R (5) Connect the electrical connector to the selector valve, ensuring that the mating surfaces are clean and undamaged.

R (6) Remove the safety clips and reset the circuit
R breakers tripped in operation B.(2).

E. Conclusion

(1) Check that all the green system hydraulic controls are correctly positioned in relation to the state of the associated systems.

(2) Replenish and charge the hydraulic system in
R accordance with the system requirements (Ref.
R 12-12-29).

(3) Connect and supply ground hydraulic power to the
R green hydraulic system (Ref. Chap.29).

(4) Make available electrical ground power as detailed in 24-41-00.

R (5) Set BATT A and BATT B control switches to "ON".

R (6) Set the AC FREQ/VOLTS selector switch to "EMERG PWR".

(7) Set the emergency generator mode switch to "MANUAL" and check that the frequency meter indicates 400(+or-12) Hz.

(8) Return the emergency generator mode switch to "AUTO".

R (9) Return the AC FREQ/VOLTS switch to "GRND PWR".

(10) Set the BATT A and BATT B control switches to
R "OFF".

(11) Switch off and disconnect the ground hydraulic supply (Ref. Chap.29).

(12) Switch off and disconnect electrical ground power as detailed in 24-41-00.

(13) Check the hydraulic selector valve and pipe unions for freedom from leaks.

(14) Replenish the hydraulic system as necessary
R (Ref. 12-12-29).

(15) Refit the access door removed in operation B.(4).

MAIN AC GENERATION - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001, 002 and 003)

Main a.c. power of 200/115 V three-phase 400 Hz is generated by four integrated drive generators (IDGs) mounted one on each engine and numbered 1, 2, 3 and 4 accordingly. Each IDG is a self-contained unit consisting of a 60 kVA generator and an axial gear transmission which drives the generator at a constant speed throughout the normal operating speed of the engine.

Each generator is connected to a correspondingly numbered main, three-phase busbar by a generator circuit breaker (GCB). Nos.1 and 2 main busbars can be linked to a synchronizing busbar (bus-tie bar) through two bus-tie breakers (BTBs) to form sub-system A on one side of the aircraft; Nos.3 and 4 main busbars can be similarly linked through two further BTBs to form sub-system B on the other side. The two sub-system bus-tie bars can also be linked through two split system breakers (SSBs), so that the generators can thus be operated either singly or in parallel combinations, with up to all four in parallel, to meet all operational requirements.

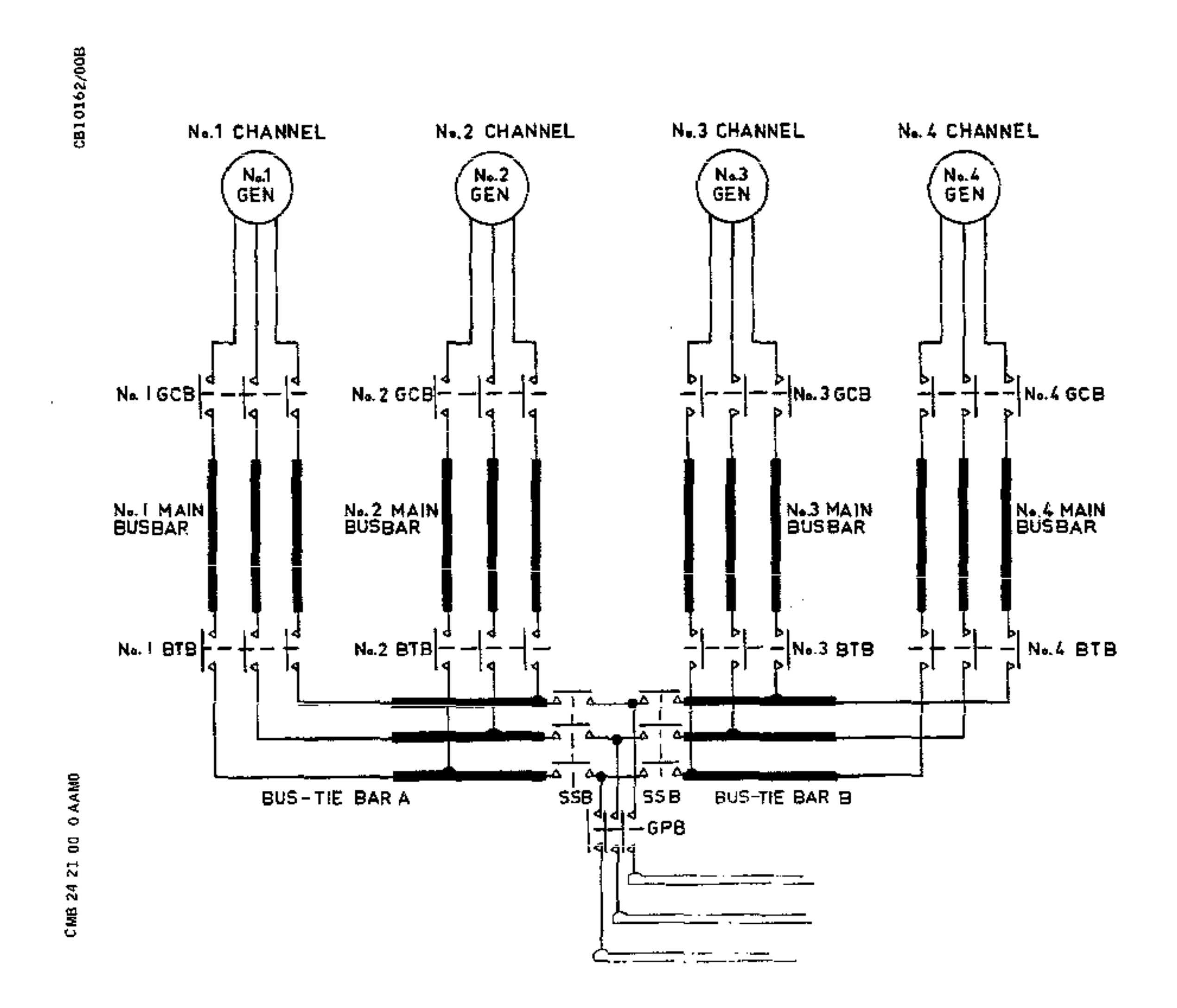
Normally, all four channels operate in parallel but if a faulty source is isolated, the remaining generators can supply all busbar loads.

The main generation system is automatically controlled by four control and protection units (CPUs), one in each generator channel, but manual control of the GCBs, BTBs and SSBs is provided at the third crew member's station to permit isolation of a power source or selection of single or parallel channel combinations as required. Each CPU provides generator voltage stabilization, auto-paralleling and, in conjunction with a current transformer unit in each channel, protection of the generator against various overload or differential load faults.

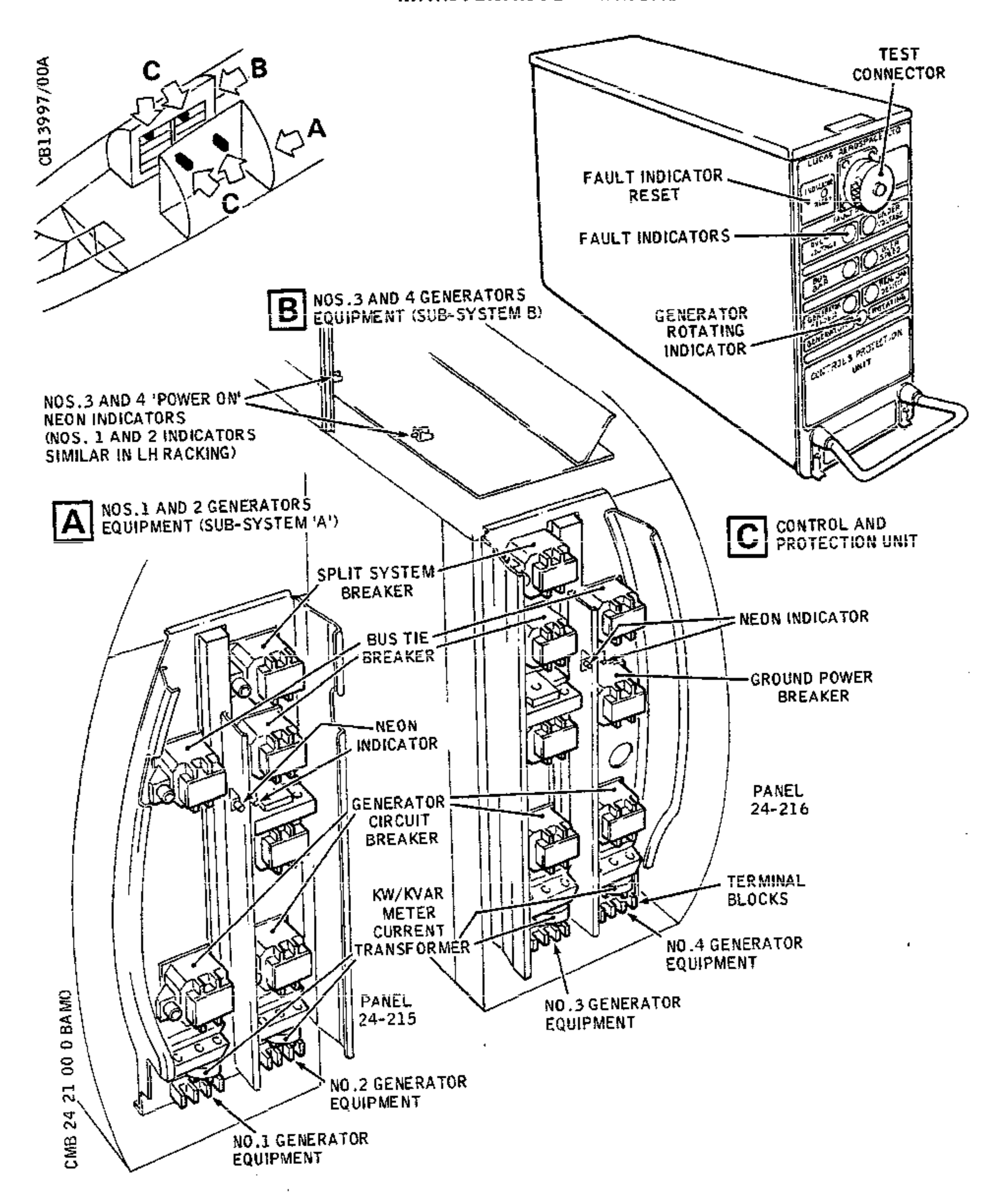
Four essential a.c. busbars are normally connected one to each main a.c. busbar by an associated change-over contactor. These contactors are controlled so that, with loss of supply at a main a.c. busbar, the affected essential a.c. busbar(s) can be supplied by an emergency a.c. generator (Ref. 24-22-00).

External (ground) electrical a.c. power (Ref. 24-41-00) is supplied to the main busbars through a ground supply plug and ground power breaker (GPB). Initial control of the GPB is effected by a ground power protection unit operating in conjunction with the CPUs in the generator channels. This control ensures that aircraft generator power is dominant on

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- Main AC Generation - Simplified Schematic
Figure 001



Main AC Generation - Equipment
Figure 002

the main a.c. busbars and prevents the paralleling of main generation and ground power supplies.

The generation system controls and indicators are located at the third crew member's station. These include a kW/kVAR meter for each generator and an a.c. voltmeter and a frequency meter which can both be connected to monitor each channel by oeprating an adjacent selector switch. Magnetic indicators display the condition (open or closed) of the GCBs, BTBs and SSBs and warning captions indicate loss of generator output and loss of busbar power. The signals operating the warning captions are also fed to the master warning system (Ref. 33-15-00).

R A test socket (AC BUS BAR VOLT), located on panel 18-216 in the flight compartment right-hand racking, is connected across the voltmeter and frequency meter to enable the meters to be checked against instruments of known accuracy.

The generation system automatic control equipment, including the GCBs, BTBs and SSBs, is located in the flight compartment racking.

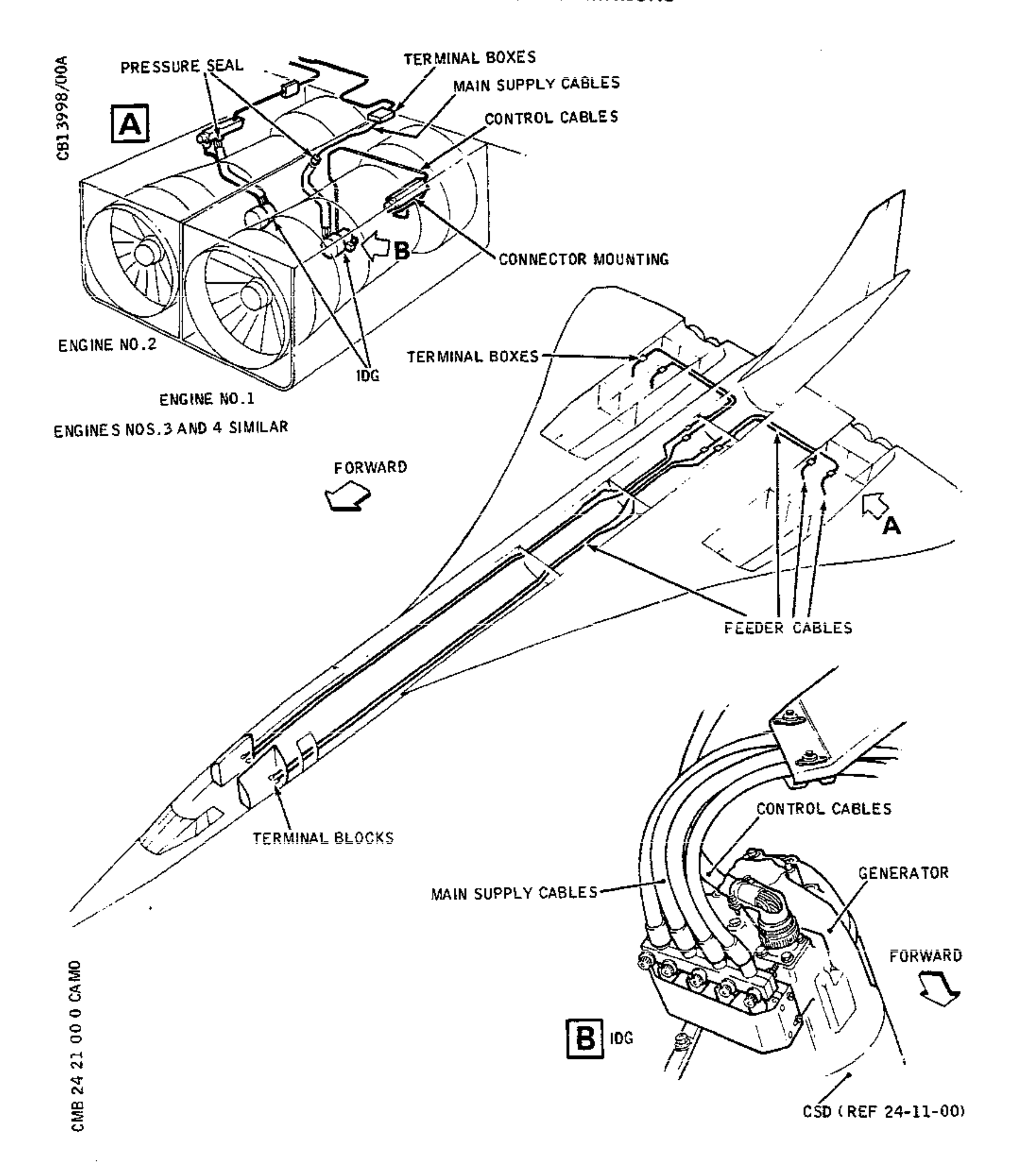
2. Integrated Drive Generator (IDG) (Ref. Fig. 003)

The generator component of an IDG is driven by the associated engine accessory gearbox through the integral axial gear transmission as described in Integrated Drive Generator (Ref. 24-11-11). The term 'constant speed drive' (CSD) is subsequently used to identify the transmission component of an IDG and the abbreviation CSD is used for the identification of associated control and indication equipment (Ref. 24-11-00, Main Generator Drive).

The generator is a three-stage brushless machine consisting of three alternators, the rotors of which are coupled to a common shaft. The first alternator provides excitation power for the second alternator which, in turn, supplies excitation power for the third main alternator, whose output powers the aircraft busbars at 200 V line and 115 V line-to-neutral.

The generator is driven by the CSD at a nominal speed of 12,000 rpm to maintain the output frequency at 400 Hz. So driven, the generator can supply a continuous output power of 60 kVA and can sustain a load of 90 kVA for 5 min. A pulse probe in the CSD supplies the CPU of the associated main generation channel with pulses having a repetition rate proportional to generator drive speed.

The first alternator, the pilot exciter, has a permanent magnet rotor producing an output from a three-phase stator



- Integrated Drive Generators (IDGs) and Feeders
Figure 003

winding. This output is rectified within the associated CPU to provide excitation current for the main exciter and power supplies for the GCB and control and protection circuits. The generator is thus independent of external power supplies.

The second alternator (main exciter) incorporates a stationary excitation field and a three-phase rotor, the outputs of which are rectified by silicon diodes embodied in the rotor and supply the rotating field of the third, main alternator.

The main alternator stator windings are star-connected, the neutral connection being brought out, together with the three-phase feeders, to a main terminal block. Three toroidal current transformers give outputs, proportional to the current in the links connecting the neutral ends of the main stator windings to the neutral terminal, for use by the differential current feeder protection circuits in the associated CPU.

The pilot exciter and main exciter stators and the differential current protection transformer leads are brought out to an electrical connector near the main terminal block.

3. Control and Protection Unit (CPU) (Ref. Fig. 002)

The CPUs provide automatic operation of the main generation system by controlling generator output voltages, generator load sharing and the automatic operation of the system contactors. The contactors are controlled to provide automatic paralleling of the generators and system protection against faults, protection being arranged to isolate faulty sections of the system whilst maintaining busbar supplies whenever possible.

No.1 and No.2 CPUs are located in the flight compartment left-hand racking on panels 2-215 and 1-215 respectively; No.3 and No.4 are located in the flight compartment right-hand racking on panels 1-216 and 2-216 respectively.

Each CPU contains a regulator section that controls the output voltage of the generator in the associated channel by varying the excitation current derived from the pilot exciter, in the generator main exciter field windings. The control maintains the average of the three line-to-neutral voltages constant within close limits, subject to an overriding limit on the highest phase voltage. When channels are operated in parallel, the excitation of each generator is varied in response to signals from a current transformer loop so as to equalize the reactive components of current in the generator outputs whilst maintaining the same voltage limits as in single-channel operation.

The current to the main exciter passes through contacts of an excitation control relay that enables the generator to be de-excited automatically when certain faults occur.

In addition to the excitation control relay (ER), the unit contains individual relays for controlling the appropriate GCB, BTB and SSB. The relays are controlled by logic circuits in response to signals from the control switches, the CSD pulse probe, the generator current transformer, the current transformer unit, the busbars and the ground power protection unit. When it is necessary for a relay to remain open when a fault is cleared, a latching circuit locks out the relay.

Six self-latching magnetic indicators are mounted on the front of the unit and are energized by the logic circuits to indicate the following faults:-

(1) Over-voltage (OVERVOLTAGE)

(2) Under-voltage (UNDERVOLTAGE)

(3) Busbar over-current or current unbalance (BUS-BAR)

(4) Generator feeder differential current (GENERATOR FEEDER)

(5) Drive overspeed (OVERSPEED)

(6) Real load deficit (REAL LOAD DEFICIT)

Each indicator displays 'black' (metallic grey) in the absence of a fault and 'white' when a fault occurs. The 'white' display remains until reset by depression of the contact button of an adjacent INDICATOR RESET microswitch that serves all indicators. This reset action is effective only while power is applied to the CPU.

A test connector above the fault indicators permits the connection of an external test set for in-situ checking of the dormant protection circuits.

Each unit provides a 28 V d.c. supply for powering the operating coil of the associated BTB. This supply is derived from the aircraft 'A' or 'B' system d.c. essential busbar. The units in Nos.2 and 3 channel positions provide a further 28 V d.c. supply for operating the SSBs, this supply being derived from the aircraft 'B' system d.c. essential busbar. An alternative supply for both circuits is provided by way of the ground power protection unit.

An indicator lamp (light emitting diode) labelled GENERATOR ROTATING is mounted below the fault indicators. This diode

is lit when the associated busbars are powered and the generator is rotating at 1,000 rpm or more, as a warning to personnel not to remove the CPU, because its removal under these conditions could result in damage to equipment.

4. Current Transformer Unit (Ref. Fig. 002)

The four current transformer units are located in the flight compartment racking: Nos.1 and 2 on panel 24-215 and Nos.3 and 4 on panel 24-216.

Each current transformer unit contains six identical toroidal-core current transformers assembled in three pairs. One of the three phases of the generator feeder cables passes through one pair of transformers as a single primary conductor; the secondary outputs of each pair are thus directly related to the current supplied by that phase of the generator.

Three transformers, one from each pair and thus fed from different phases, are star-connected to provide a three-phase-plus-neutral output to logic circuits in the CPU of the associated channel that provide differential-current, over-current and current unbalance protection. The other three transformers supply individual outputs for use as load-sharing information. Two of these provide signals to the reactive load sharing and load discrimination circuits in the CPU with loop signals to other CPUs, whilst the remaining transformer provides signals to the real-load circuits of the CSD load controller with loop signals to other load controllers (Ref. 24-11-00).

The transformer connections are brought out to an electrical connector on one side of the current transformer unit.

R **ON A/C 001-006,

5. System Contactors (Ref. Fig. 002)

The four GCBs, the four BTBs, the two SSBs and the GPB are identical contactors, each having three heavy-duty contacts to switch the three-phase supply and auxiliary contacts to perform other circuit switching functions. The actuating coils are energized by a nominal supply of 28 V d.c. The GCBs, BTBs and SSB of sub-system A are located in the flight compartment racking on panel 24-215 and those of sub-system B on panel 24-216.

One of the auxiliary contacts of each contactor is employed for signalling the condition of the main contacts (open or closed) to the associated magnetic indicator at the third crew member's station. The signalling contacts of the two SSBs are connected

in series so that both SSBs must close to operate the one indicator.

Each GCB is energized from the generator pilot supply when an associated generator control switch is set to ON, the generator is 'ready' and a 'dead' busbar or a suitable paralleling condition is sensed by the control logic circuits of the CPU in that channel. The GCB is de-energized when the generator control switch is set to OFF or TEST, during generator run-down or when fault conditions requiring generator isolation occur.

Three auxiliary contacts of the GCB and three auxiliary contacts of the associated BTB are each connected across an output of one of the three transformers supplying load-sharing information in the current transformer unit of the channel so that, when both contactors are de-energized, each transformer primary is shunted by a GCB and a BTB contact. The signals are thus removed, without interrupting the loop connections for the other channels, when the generator is not supplying the channel or when the channel is isolated by the BTB. A contact of each GCB is in series with the supply to the ground power breaker (GPB) actuating coil so that this contactor is always de-energized whenever a GCB is energized.

The BTB, when energized, connects the main busbar of its channel to the sub-system bus-tie bar, thereby paralleling the generator channel with other channels. Each BTB is individually controlled by a BTB control switch in conjunction with the CPU of its channel, power for BTB operation being supplied from an essential d.c. busbar. The BTB is energized when the BTB control switch is set to NORM and no faults are sensed by the CPU.

The BTB is de-energized, manually, by setting the BTB control switch momentarily to TRIP and, automatically, when power is removed from the d.c. busbars or when a fault condition requiring channel isolation occurs. Some faults cause the BTB to be de-energized and then to be re-energized automatically upon subsequent trip of the GCB. When tripped either manually or automatically the BTB can be re-energized by setting the control switch momentarily to RESET and then back to NORM.

The SSBs serve to split the main generation system into two sub-systems and isolate the two sub-systems from the output side of the GPB. The two SSBs are controlled by one SSB control switch in conjunction with the CPUs of channels 2 and 3 when a d.c. supply is provided to the two units either from the aircraft busbars or from the ground power protection unit. The SSBs are energized and remain energized when the SSB

control switch is set to CLOSE and the two units sense either a 'dead' busbar signal or suitable auto-paralleling conditions between the two bus-tie bars. The SSBs are de-energized upon loss of d.c. power or when the control switch is set to OPEN, and are not automatically tripped by fault conditions. Contacts on the SSBs, when de-energized, shunt the series load-sharing transformer connections between the two generating sub-systems, thus splitting the load-sharing loops into two separate systems.

Auxiliary contacts of each SSB are associated with the Warning and Landing Display System (Ref. 22-41-00).

The GPB (Ref. 24-41-00) is controlled by the ground power control switch and by the ground power protection unit operating in conjunction with the CPUs of all four channels. If external power is available, all GCBs de-energized and no generator 'ready', the GPB is then energized when the ground power control switch is momentarily set to CLOSE. The GPB is de-energized when the ground power control switch is momentarily set to TRIP or a 'generator ready' signal is provided by any CPU.

R **ON A/C 006-006,

R The GPB is de-energized automatically after a 45 s time delay
R in the event of an equipment bay cooling fault (Ref. 24-41-00).

R **ON A/C 007-007,

5. System Contactors (Ref. Fig. 002)

The four GCBs, the four BTBs, the two SSBs and the GPB are identical contactors, each having three heavy-duty contacts to switch the three-phase supply and auxiliary contacts to perform other circuit switching functions. The actuating coils are energized by a nominal supply of 28 V d.c. The GCBs, BTBs and SSB of sub-system A are located in the flight compartment racking on panel 24-215 and those of sub-system B on panel 24-216.

One of the auxiliary contacts of each contactor is employed for signalling the condition of the main contacts (open or closed) to the associated magnetic indicator at the third crew member's station. The signalling contacts of the two SSBs are connected in series so that both SSBs must close to operate the one indicator.

Each GCB is energized from the generator pilot supply when an associated generator control switch is set to ON, the generator is 'ready' and a 'dead' busbar or a suitable

paralleling condition is sensed by the control logic circuits of the CPU in that channel. The GCB is de-energized when the generator control switch is set to OFF or TEST, during generator run-down or when fault conditions requiring generator isolation occur.

Three auxiliary contacts of the GCB and three auxiliary contacts of the associated BTB are each connected across an output of one of the three transformers supplying load-sharing information in the current transformer unit of the channel so that, when both contactors are de-energized, each transformer primary is shunted by a GCB and a BTB contact. The signals are thus removed, without interrupting the loop connections for the other channels, when the generator is not supplying the channel or when the channel is isolated by the BTB. A contact of each GCB is in series with the supply to the ground power breaker (GPB) actuating coil so that this contactor is always de-energized whenever a GCB is energized.

The BTB, when energized, connects the main busbar of its channel to the sub-system bus-tie bar, thereby paralleling the generator channel with other channels. Each BTB is individually controlled by a BTB control switch in conjunction with the CPU of its channel, power for BTB operation being supplied from an essential d.c. busbar. The BTB is energized when the BTB control switch is set to NORM and no faults are sensed by the CPU.

The BTB is de-energized, manually, by setting the BTB control switch momentarily to TRIP and, automatically, when power is removed from the d.c. busbars or when a fault condition requiring channel isolation occurs. Some faults cause the BTB to be de-energized and then to be re-energized automatically upon subsequent trip of the GCB. When tripped either manually or automatically the BTB can be re-energized by setting the control switch momentarily to RESET and then back to NORM.

The SSBs serve to split the main generation system into two sub-systems and isolate the two sub-systems from the output side of the GPB. The two SSBs are controlled by one SSB control switch in conjunction with the CPUs of channels 2 and 3 when a d.c. supply is provided to the two units either from the aircraft busbars or from the ground power protection unit. The SSBs are energized and remain energized when the SSB control switch is set to CLOSE and the two units sense either a 'dead' busbar signal or suitable auto-paralleling conditions between the two bus-tie bars. The SSBs are de-energized upon loss of d.c. power or when the control switch is set to OPEN, and are not automatically tripped by fault conditions. Contacts on the SSBs, when de-energized, shunt the series

load-sharing transformer connections between the two generating sub-systems, thus splitting the load-sharing loops into two separate systems.

Auxiliary contacts of each SSB are associated with the Warning and Landing Display System (Ref. 22-41-00).

The GPB (Ref. 24-41-00) is controlled by the ground power control switch and by the ground power protection unit operating in conjunction with the CPUs of all four channels. If external power is available, all GCBs de-energized and no generator 'ready', the GPB is then energized when the ground power control switch is momentarily set to CLOSE. The GPB is de-energized when the ground power control switch is momentarily set to TRIP or a 'generator ready' signal is provided by any CPU.

R

The GPB is de-energized automatically after a 45 s time delay in the event of an equipment bay cooling fault (Ref. 24-41-00).

6. kW/kVAR Meter (Ref. Fig. 004)

Four kW/kVAR meters, one for each generator, are located on panel 3-214 at the third crew member's station. The meters provide indication of either real or reactive power supplied by the associated generator. Normally, the meters all read kW but, when an adjacent PUSH FOR KVAR push-button is operated, all meters read kVAR.

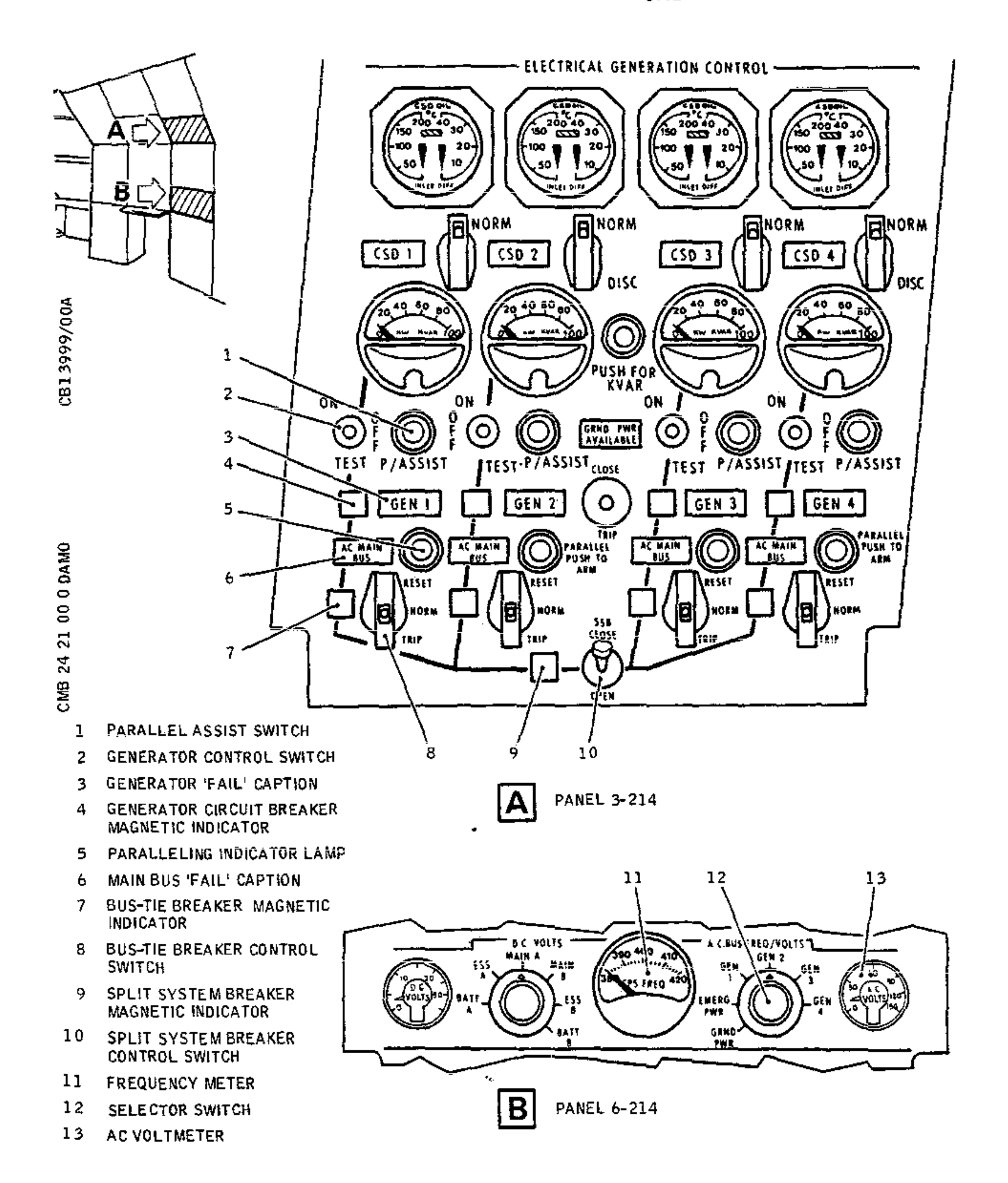
Each meter measures power at the feeder cables between the generator and the GCB, the instrument current coil being supplied from a current transformer on the phase A feeder. The instrument voltage coil is normally connected between this feeder through a circuit breaker and relay contacts and ground. When the PUSH FOR KVAR button is operated, the relay is energized and the coil is now connected, through further circuit breakers and a resistor, between phases B and C of the feeders.

The instrument current transformer units are located in the flight compartment racking: Nos.1 and 2 on panel 24-215 and Nos.3 and 4 on panel 24-216 (Ref. Fig. 002).

7. Voltmeter (Ref. Fig. 004)

An a.c. voltmeter on panel 6-214, in conjunction with a rotary selector switch (AC FREQ/VOLTS), indicates the voltage of any one of the four main generators, the emergency generator or the ground power supply.

8. Frequency Meter (Ref. Fig. 004)



- Main AC Generation - Controls and Indicators
Figure 004

A frequency meter mounted on the same panel and connected in parallel with the voltmeter indicates the frequency of the supply source selected on the AC FREQ/VOLTS selector switch.

9. Operation (Ref. Fig. 004, 005 and 006)

A. Control and Indication (Ref. Fig. 004)

The majority of the controls and indicators are located on the upper part of the electrical generating control panel (panel 3-214) with the frequency meter, voltmeter and selector switch on the lower part of the panel (panel 6-214). 'Power on' neon indicators on the equipment shelves 12-215 and 12-216 and on the equipment panels 24-215 and 24-216 indicate to servicing personnel that the 200/115 V circuits are 'live' (Ref. Fig. 002).

The controls and indicators are positioned with interconnection lines engraved on the panel, to form an operational diagram of the main generating system. The magnetic indicators show 'in-line' or 'cross-line' with respect to the interconnection lines to denote the corresponding closed or open position of the related GCB, BTB or SSBs and thus depict connection or disconnection between the separate generating channels.

The generator control switches are each located below the corresponding channel kW/kVAR meters. The switches have the positions ON, OFF and TEST, which control the associated generator as follows:-

ON: permits normal generator operation and arms the GCB actuating coil circuit.

OFF: de-excites the generator and interrupts the GCB actuating coil circuit.

TEST: permits the generator to run up to speed and be controlled at the correct voltage and frequency but prevents closure of the GCB.

A P/ASSIST switch for each generator can be operated momentarily to increase the generator frequency by between 3 Hz to 4 Hz and so provide more rapid paralleling if the generator runs up to the same speed as a generator or generators already on line, but at an incorrect phase angle (Ref. 24-11-00).

In each channel a GCB magnetic indicator and a generator 'fail' caption both indicate that the generator of that channel is disconnected from the busbar. The 'fail'

caption (GEN 1, 2, 3 or 4) is operative with the associated generator control switch at any one of the three positions; it is always illuminated with the switch set to OFF or TEST and at ON before the generator is connected to the busbar or if the generator subsequently fails.

An AC MAIN BUS caption is illuminated if the voltage of the associated main busbar drops below a predetermined level. (Ref. 24-51-00).

The GEN and AC MAIN BUS caption light modules incorporate a press-to-test facility and the filaments in the caption lights can be tested/dimmed by the flight compartment lights test and dimming facility (Ref. 33-14-00).

The bus-tie breakers are normally closed but can be individually controlled by guarded switches, each with the following three positions:-

RESET: Momentarily set to this position to close the associated BTB after a manual or automatic trip and is spring-returned to NORM.

NORM: Allows automatic paralleling of the generator with other generators.

TRIP: Opens the BTB, as indicated by the BTB magnetic indicator of that channel.

If the BTB is de-energized by a fault and is not then automatically re-energized (with the control switch at NORM) the BTB can be re-energized by momentarily setting the switch to RESET. If the fault is not cleared, the BTB is de-energized irrespective of the switch setting.

For each channel, a PARALLEL lamp is contained in the normally retracted knob of a push-switch labelled PUSH TO ARM. The switch assists manual paralleling and when operated, i.e., the knob is momentarily pressed and released, the knob extends and the light cycles dim and bright at the rate of frequency difference between the generator and synchronizing busbars (bus-tie bars); the BTB can be closed when the light is dim. If the synchronizing busbar is 'dead', the light is steadily lit at half brilliance.Pressing the knob after use extinguishes the light and resets the knob in the retracted position.

An SSB two-position control switch and SSB magnetic indicator are located below channels 2 and 3 BTB control switches. The magnetic indicator shows 'in-line' only

when both SSBs are energized. The switch controls both SSBs as follows:-

OPEN: Interrupts the d.c. supply to both SSB actuating coils and opens the SSBs.

CLOSE: Permits the SSBs to be energized if d.c. power is available and the CPUs in channels 2 and 3 sense either a 'dead' busbar or suitable auto-paralleling conditions between the two bus-tie bars of sub-systems A and B.

The SSBs are not automatically tripped to provide fault protection.

The GPB (Ref. 24-41-00) is primarily controlled by a toggle switch having two control positions, CLOSE and TRIP, from which the toggle is spring-returned to a central, neutral position. When energized the GPB connects the external power to the aircraft busbars by way of the two SSBs when these are energized. The GPB is automatically tripped when a 'generator ready' signal is provided by any channel CPU.

B. Functional Description (Ref. Fig.005 and 006)

The generator control switches are normally set at ON, the BTB switches at NORM and the SSB switch at CLOSE. These contactors will thus be closed to parallel all busbars, the operating coil supply via the CPUs being provided by the aircraft d.c. essential busbars or the alternative supply from the ground power protection unit.

When the first engine is started and the generator runs up to speed, the CPU logic produces a 'generator ready' signal when the CSD pulse probe frequency has indicated a generator rotor speed of approximately 11,400 rpm for between 1.5 and 2.5 s and the average line-to-neutral voltage exceeds 100 V r.m.s. (nominal). The GPB is now automatically opened to disconnect external power from the main busbars, and with a 'dead busbar' signal (20 V r.m.s. or less) sensed at the main busbar, the logic circuits cause the GCB to be energized immediately. The generator is thus connected to the associated main busbar and to all other busbars now connected to the generator channel via the BTBs and SSBs.

On generator run-up, the pilot exciter supply powers all circuits associated with generator control in the CPU of that channel. When the pilot exciter supply voltage reaches a predetermined level, the excitation control relay

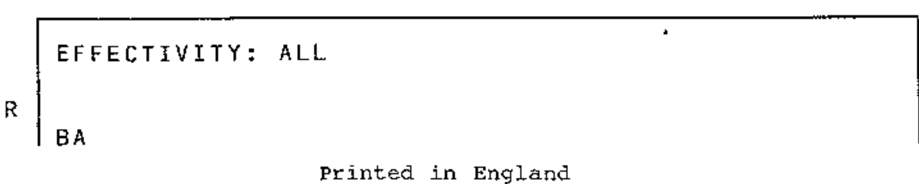
CMB 24 21 00 0 EAM0

CB14000/00A

ELECTRICAL GENERATING CONTROL PANEL

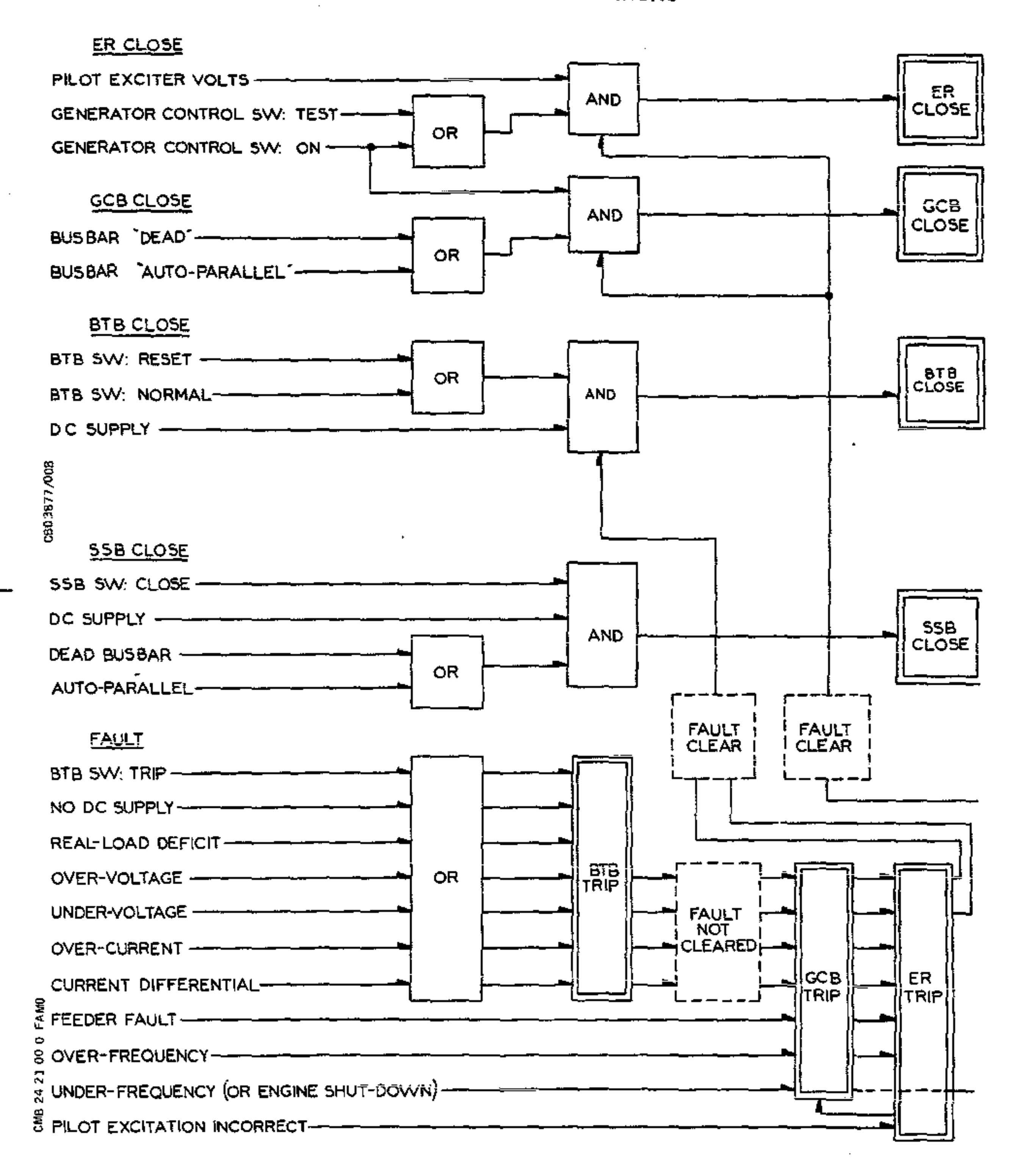
IDG
CSD
GENERATOR
CTU
CSD OIL TEMP INDICATOR
CSD FAIL CAPTION
NORM
DISC
LOAD CONTROLLER
KW/KVAR INDICATOR
INST CTU
CTU
CONTROL AND PROTECTION UNIT
ON
OFF
GEN TEST
PUSH SW
P/ASSIST
GEN FAIL CAPTION
GCB
GCB POSN INDICATOR
PARALLEL PUSH TO ARM
200/115 V MAIN BUSBAR
BTB POSN INDICATOR
RESET
NORM
TRIP
BTB
SSB CLOSE
Nos. 2&3 CHANNELS ONLY
'A' SUB-SYSTEM BUS-TIE BAR
SSB POSN INDICATOR
SSB
SSB
OPEN
'B' SUB-SYSTEM BUS-TIE BAR

Typical Main AC Generation Channel
Figure 005


EFFECTIVITY: ALL

R

BA



Main AC Generation - Contactor Control
Figure 006

(ER) closes to energize the main exciter, the output of which, in turn, energizes the main generator. The voltages of the three phases of the generator output are monitored in the CPU by two regulator sensors, one of which senses the average voltage of the three phases and the other the highest peak value. The regulator circuits control the excitation current into the main exciter so that the generator output is maintained at the correct voltage level, irrespective of load variations, but without exceeding the maximum voltage level on any one phase.

With the busbars paralleled before the second and subsequent generators are run up, the logic circuits in the CPUs of those channels permit the related GCB to be energized only when auto-paralleling conditions are satisfied. These occur when the generator output is within 5 Hz and 90 deg of the busbar frequency and phase and within 10 V r.m.s. of the busbar voltage. The SSBs are energized, if the control switch is set to CLOSE after the the two sub-system busbars are energized, only when auto-paralleling conditions exist between the two sub-system bus-tie bars, as sensed by the CPUs of channels 2 and 3. BTB closure is not inhibited in the absence of auto-paralleling conditions. A BTB must, therefore, be reset manually, using the 'parallel' light, as previously described, if the BTB is open when the associated bus-tie bar is energized.

With the GCBs and BTBs energized, the contacts shunted across the secondaries of the load-sharing transformers in the current transformer units are now opened, thus applying the load-sharing signals to the CPUs and the the CSD load controllers of the related channels (Ref. 24-11-00). When the SSBs are energized, the shunts across the two sub-system connections are removed so that the four transformer secondaries of each group are connected in one series loop. The excitation of each generator is now varied, in response to the loop signals, to equalize the reactive component of current in each generator output and, at the same time, maintain the same voltage limits as in single-channel operation.

The generation system is automatically protected against differential load, overload and generator drive faults that could cause damage to generators or equipment supplied by the busbars. Protection is achieved by control of the GCBs, BTBs and generator excitation by sensing and logic circuits in each CPU. Some logic inputs are derived directly from the signals supplied by the current transformers in the generator and current transformer unit, the busbar voltages and the CSD pulse probe, while others are

derived by comparison or combination of more than one signal.

Protection against faults causing unequal reactive load division is combined with the undervoltage and overvoltage protection described in the following paragraphs. If a difference exists between the reactive load current supplied by one phase of a generator channel and the average supplied by the corresponding phase of all other generator channels in parallel, a signal proportional to the difference is generated. An increase in differential reactive current thus causes an increase in the voltage signal applied to the undervoltage and overvoltage protection logic.

The figures quoted in the following text are approximations for guidance only and it is assumed that the affected channel is operating in parallel with one or more other channels.

If the real-load current supplied by a channel in parallel combination is less than the average of the real load currents supplied by all the channels of that combination (real-load deficit) by a margin of more than 52 A r.m.s. for more than 7 s, the BTB of that channel is de-energized.

The BTB is also de-energized if the combined busbar voltage and differential reactive-load current signal previously referred to exceeds a value corresponding to an average single-channel busbar voltage of 130 V. The delay between the commencement of a fault and protective action varies inversely with the magnitude of the voltage error, the delay time being decreased for large errors. If the fault persists after this corrective action, the GCB of the affected channel is de-energized, the generator de-excited and the BTB then automatically re-energized.

Undervoltage protection in a particular channel is inhibited if the voltage error is caused by an overcurrent or differential phase current fault as described below. If, whilst the CSD pulse probe output indicates a generator rotor speed of at least 11,100, the combined busbar voltage and reactive load signal falls below a value equivalent to an average single-channel busbar voltage of 99 V for at least 1.25 s, the BTB of the affected channel is de-energized. If the fault persists after channel isolation, the GCB of that channel is rapidly de-energized, the generator de-excited and the BTB then automatically re-energized.

If a current exceeding 415 A r.m.s. is supplied by any

phase of the generator channel, undervoltage protection is inhibited and, if the fault persists, the BTB of that channel is de-energized after an inverse time delay. If the fault persists after channel isolation, the channel GCB is rapidly de-energized and the generator de-excited. The BTB is not automatically re-energized.

Undervoltage protection is inhibited if the current supplied by any phase of a generator channel differs from that supplied by any other generator phase of that channel by more than 150 A r.m.s. If an unbalance current persists for a period governed by the magnitude of the error, the BTB of the affected channel is de-energized. If the phase current differential persists after channel isolation, the GCB is rapidly de-energized and the generator de-excited. The BTB is not automatically re-energized.

Feeder current is monitored by comparing the output of the generator current transformers with that from the star-connected transformers in the current transformer unit of the generator channel. If the current in any phase of the generator neutral connection differs from the current in the same phase at the GCB by more than 55 A r.m.s. (indicating a feeder fault), the GCB is rapidly de-energized and the generator de-excited.

The channel GCB is de-energized and the generator de-excited if the associated pulse-probe frequency indicates a generator rotor speed in excess of 12,900 rpm (over-frequency).

If the pulse-probe frequency indicates a generator rotor speed below 11,100 rpm (under-frequency or generator run-down), the GCB only is de-energized and this is automatically re-energized when the fault clears.

The automatic and manual control of system contactors and generator excitation control relay (ER) is summarized in Figure 6. The operation of the CPU in this function, and its other control functions, are explained in detail in 24-21-21.

Printed in England

MAIN AC GENERATION - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains the Main AC Generation System Test, which is a comprehensive test carried out at major maintenance periods of the aircraft. It is divided, for convenience of application, into a series of tests identified under separate sub-headings as follows:-

Preliminary

Main Generation Differential (Feeder) Protection Current Transformers

Main Generation Dormant Circuits

Final - Main Engines Running

It is recommended that this series of tests be run as a complete sequence. At the conclusion of individual tests, certain operations, e.g., switching off electrical ground power, may be omitted provided that a sequential test validates the omission.

Operational and Functional Tests are not included because the checks of the Main AC Generation System that are required under each of these headings are incorporated in the Operational Test and the Functional Test in the General section (Ref. 24-00-00, Adjustment/Test).

NOTE: On the electrical generating control panel, the abbreviation CSD (constant speed drive) is used on associated control and indication equipment to identify the transmission component of the IDG (integrated drive generator) in each main generation channel.

The Final test includes a check of the IDG (CSD) disconnect facility in each main generation channel; the System Test required for the CSDs is in the Main Generator Drive section (Ref. 24-11-00, Adjustment/Test).

2. System Test

A. Equipment and Materials

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED

TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL CONNECTORS.

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Dormant circuit test set, required for Main Generation Dormant Circuits test and Main Generation Differential (Feeder) Protection Current Transformers test.	TE5002000
Precision-grade AC voltmeter, calibrated to provide accurate readings in the range of 110 to 125 V a.c.; required for Final test.	-
Precision-grade frequency meter, calibrated to provide accurate readings in the range of 350 to 450 Hz; required for Final test.	-

B. Preliminary

(1) Prepare

(a) Make available electrical ground power as detailed in 24-41-00, Servicing.

(2) Test

R **ON A/C 007-007,

(a) Set BATT A and BATT B control switches to "ON" and check that the associated magnetic indicators change from cross-line to in-line.

R **ON A/C 001-006,

(a) Set BATT A and BATT B control switches to "BATT ON" and check that the associated magnetic indicators change from cross-line to in-line.

(b) Set the split system breaker (SSB) control switch to "OPEN" and check that both SSBs open, by observing that all four AC MAIN BUS captions are illuminated. Check also that the SSB magnetic indicator changes from in-line to cross-line.

NOTE: The AC ESS BUS captions will also be illuminated.

(c) Return the SSB control switch to "CLOSE" and check that the four AC MAIN BUS captions are extinguished and the SSB magnetic indicator changes from cross-line to in-line.

(d) Set No.1 bus-tie breaker (BTB) control switch to "TRIP" and check that No.1 BTB opens, by observing that No.1 AC MAIN BUS caption is illuminated and the associated magnetic indicator changes from in-line to cross-line. Check also that No.1 AC ESS BUS caption is illuminated and the associated magnetic indicator changes from in-line to cross-line.

(e) Return No.1 BTB control switch to "NORM" and check that the associated AC MAIN BUS and AC ESS BUS captions are extinguished and the associated magnetic indicators change from cross-line to in-line.

(f) Repeat operations (d) and (e) as applied to Nos.2, 3 and 4 BTBs, in turn.

(g) Set each transformer rectifier (TRU) control switch, in turn, to "ISOL" and check that each TRU ammeter indication falls to zero as the associated ISOL setting is made. When all four TRUs are isolated, check that the DC MAIN BUS caption is illuminated and the essential/main split magnetic indicators display cross-line.

NOTE: Isolation of the d.c. main busbar is initiated by undervolt detectors that have an inverse time delay and, normally, d.c. main busbar isolation will occur between 2 and 20 s after the last TRU is switched off.

R **ON A/C 007-007,

(h) With the four TRUs isolated, select "OFF" at

BATT A control switch and check that 'A' system DC ESS BUS caption is illuminated.

(i) Return BATT A control switch to "ON" and check that the 'A' system DC ESS BUS caption is extinguished.

R **ON A/C 001-006,

(h) With the four TRUs isolated, select "BATT OFF" at BATT A control switch and check that 'A' system DC ESS BUS caption is illuminated.

(i) Return BATT A control switch to "BATT ON" and check that the 'A' system DC ESS BUS caption is extinguished.

(j) Repeat operations (h) and (i) as applied to BATT B.

(k) Return all four TRU control switches to "NORM" and check that the DC MAIN BUS caption is extinguished and the essential/main split magnetic indicators return to in-line.

R **ON A/C 007-007,

(l) Set BATT A and BATT B control switches to "OFF" and check that the associated magnetic indicators change from in-line to cross-line.

R **ON A/C 001-006,

(l) Set BATT A and BATT B control switches to "BATT OFF" and check that the associated magnetic indicators change from in-line to cross-line.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00, Servicing.

C. Main Generation Differential (Feeder) Protection Current Transformers

CAUTION: DURING THE FOLLOWING TESTS ENSURE THAT ALL AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN AND EXTERNAL POWER MUST NOT BE CONNECTED TO THE AIRCRAFT.

NOTE: As applied to each main generating channel, this test checks the integrity of the secondary windings of the differential protection current transformers that are incorporated, one set in the current transformer unit in the channel feeder lines and the other set in the generator.

(1) Prepare

(a) Prepare to remove Nos.1, 2, 3 and 4 control and protection units (CPUs) by tripping the following circuit breakers and fitting safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
SSB CONT	3-213	X29	F12
No.1 GEN CONT UNIT SUP	1-213	1X4	P7
No.2 GEN CONT UNIT SUP	1-213	2X4	P8
No.3 GEN CONT UNIT SUP	3-213	3X4	E8
No.4 GEN CONT UNIT SUP	3-213	4X4	E9

(b) Gain access to Nos.1, 2, 3 and 4 CPUs, 1X3 on shelf 2-215, 2X3 on shelf 1-215, 3X3 on shelf 1-216 and 4X3 on shelf 2-216 in the flight compartment racking, by removing the appropriate panels. Check at the front of each CPU that the GENERATOR ROTATING indicator lamp is not lit.

(c) Remove Nos.1, 2, 3 and 4 CPUs. At each unit:-

c1) Loosen the clamp nut and disconnect the hold-down screw assembly from the CPU hold-down lug.

c2) Carefully withdraw the CPU from the electrical connector on the shelf junction box and the shelf.

(d) Check that the 28 V supply switch on the dormant circuit test set is set to OFF and that all other switches on the test set are set to position 1.

(2) Test

(a) Connect a 28(±1) V d.c. supply to the test set and connect the test connector to No.1 CPU electrical connector 1X3-AB on the shelf junction box. Carry out on No.1 channel the operations detailed in Table 501. Disconnect the 28 V supply and the test set on completion.

NOTE: S1 refers to test set switch 1. On the set, switch S1 is identified only by the number of engraved positions, i.e., positions 1-20. The 'VOLTS' readings are those registered on the test set voltmeter.

A volts reading of 10(±1) indicates a short-circuited current transformer secondary winding.

A volts reading of 0 indicates an open circuit of a current transformer secondary winding.

(b) Repeat operation (a) on Nos.2, 3 and 4 channels, using the applicable CPU electrical connector on the shelf junction box, as follows:-

No.2 channel: connector 2X3-AB

No.3 channel: connector 3X3-AB

No.4 channel: connector 4X3-AB

OPERATION	VOLTS INDICATION
1. Test Set Power Supply:	
(1) Set 28 V supply switch on test set to "ON"	12(±1)
2. Secondary Winding - Current Transformer Unit:	

OPERATION	VOLTS INDICATION
(1) Phase A: Set S1 to position "13"	6(±2)
(2) Phase B: Set S1 to position "14"	6(±2)
(3) Phase C: Set S1 to position "15"	6(±2)
3. Secondary Winding - Generator (IDG) Transformer:	
(1) Phase A: Set S1 to position "16"	6(±2)
(2) Phase B: Set S1 to position "17"	6(±2)
(3) Phase C: Set S1 to position "18"	6(±2)

Differential Protection Current Transformer Test
Table 501

(3) Conclusion

(a) Refit Nos.1, 2, 3 and 4 CPUs. At each unit:-

a1) Place the unit on the shelf and carefully slide it back until the electrical connector is fully engaged with the mating connector on the shelf junction box.

a2) Ensure that the unit is bonded in accordance with 20-27-11.

a3) Engage the hold-down screw assembly with the CPU hold-down lug and secure the clamp nut.

(b) Remove the safety clips and reset the circuit breakers tripped in operation (1)(a).

(c) Refit the panels removed in operation (1)(b).

D. Main Generation Dormant Circuits

CAUTION: DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR

MUST NOT BE RUN.

(1) Prepare

(a) Connect electrical ground power to the ground services distribution system only (Ref. 24-41-00, Servicing, para.2.A.). If already connected, ensure that ground power is disconnected from the main a.c. distribution system, by setting the ground power control switch to the TRIP position.

(b) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(c) Gain access to Nos.1, 2, 3 and 4 control and protection units (CPUs), 1X3 on shelf 2-215, 2X3 on shelf 1-215, 3X3 on shelf 1-216 and 4X3 on shelf 2-216 in the flight compartment racking, by removing the appropriate panels.

R **ON A/C 007-007,

(d) Ensure that BATT A and BATT B control switches are set to OFF.

R **ON A/C 001-006,

(d) Ensure that BATT A and BATT B control switches are set to BATT OFF.

(e) Set all four generator (GCB) control switches to "OFF".

(f) Check that the SSB control switch is at CLOSE, the BTB control switches are at NORM, the GCB magnetic indicators display cross-line, the BTB magnetic indicators display in-line and the fault indicators on the front of all four control and protection units (CPUs) display 'all black' (no faults).

(g) Check that the 28 V supply switch on the dormant circuit test set is set to OFF and that all other switches on the test set are set to position 1.

(2) Test

(a) Using the appropriate cable loom and connector

supplied therewith, connect the test set to the connector on the front of No.1 CPU.

NOTE: The 28 V d.c. external supply connector on the test set is not used for dormant circuit tests.

(b) Carry out the applicable operations detailed in Table 502 as applied to No.1 channel. Disconnect the test set on completion.

NOTE: Switch numbers prefixed 'S' are test set switches. On the set, switch S1 is identified only by the number of engraved positions, i.e., positions 1-20; switches S2 to S7 are identified by corresponding engravings, i.e., SW2 to SW7. The 'VOLTS' readings are those registered on the test set voltmeter.

(c) Repeat operations (a) and (b) as applied to Nos.2, 3 and 4 channels, in turn.

(3) Conclusion

(a) Refit the panels removed in operation (1)(c).

(b) Remove the warning placard placed in operation (1)(b) and switch off and disconnect electrical ground power as detailed in 24-41-00, Servicing.

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
1. CPU Internal Power Supplies:				
(1) Set 28 V supply switch on test set to "ON" and check that the GENERATOR ROTATING indicator lamp on the front of the CPU is	12(±1)	All black	Cross-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
lit				
(2) Set S1 to "2"	12(±1)	All black	Cross-line	In-line
(3) Set S1 to "3" -				
Channels				
1 and 4	0	All black	Cross-line	In-line
2 and 3	12(±1)	All black	Cross-line	In-line
(4) Ensure that SSB control switch is set to "CLOSE"	-	-	-	-
(5) Set SSB control switch to "OPEN" (channels 2 and 3 only)	0	-	-	-
(6) Set SSB control switch to "CLOSE" (channels 2 and 3 only)	12(±1)	-	-	-
(7) Set S1 to "4"	12(±1)	All black	Cross-line	In-line
(8) Set S1 to "5"				
Channels				
1 and 4	0	All black	Cross-line	In-line
2 and 3	12(±1)	All black	Cross-line	In-line
(9) Set SSB control switch to "OPEN" (channels 2 and 3 only)	0	-	-	-
(10) Set SSB control switch to "CLOSE" (channels 2 and 3 only)	12(±1)	-	-	-
(11) Set S1 to "6"	12(±1)	All black	Cross-line	In-line.

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
NOTE: Operation (11) checks test set function only.				
2. Overspeed Circuit:				
(1) Set S1 to "7" and the GCB control switch to "ON"	6(±1)	All black	In-line	In-line
(2) Set S1 to "8" and S7 to "3"	6(±1)	OVERSPEED: white	Cross-line	In-line
(3) Set S7 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	6(±1)	All black	In-line	In-line
3. Average Voltage Sensing Circuit:				
(1) Set S1 to "9" and S2 to "2"	11(±2)	All black	In-line	In-line
4. High Phase Sensing Circuit:				
(1) Set S2 to "1"	6(±1)	All black	In-line	In-line
(2) Set S1 to "10" and S2 to "2"	11(±2)	All black	In-line	In-line
5. Current Limit:				
(1) Set S2 to "1"	6(±1)	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(2) Set S1 to "11" and S2 to "2"	11(±2)	All black	In-line	In-line
6. Underspeed Circuit:				
(1) Set S2 to "1", S1 to "12" and S7 to "2"	0	All black	Cross-line	In-line
(2) Set S3 to "2" and S7 to "1"	0	UNDER-VOLTAGE: white	Cross-line	Cross-line then In-line
(3) Set S3 to "1", select "OFF" and then "ON" (reset) at the GCB control switch and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
7. Real Load Deficit Circuit:				
(1) Set S1 to "13" and S2 to "2"	0	REAL LOAD DEFICIT: white	In-line	Cross-line after 7(±3) s.
(2) Set S2 to "1" and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
8. Over-excitation (Over-voltage) Circuit:				

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(1) Set S1 to "14" and S2 to "2"	0	OVER-VOLTAGE: white	Cross-line	Cross-line
(2) Set S2 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
9. Under-excitation (Under-voltage) Circuit:				
(1) Set S1 to "15" and S3 to "2"	0	UNDER-VOLTAGE: white	Cross-line	Cross-line then In-line
(2) Set S3 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All black	In-line	In-line
10. Current Unbalance Sensing Circuit:				
(1) Set S1 to "16" and check that the indicator	-	-	-	-

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
lamp on test set is not lit				
(2) Set S2 to "2" and then S4 to "2"	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
NOTE: There is a delay between the operation and the fault display.				
(3) Set S2 and S4 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, select "RESET" and then "NORM" at the BTB control switch, and actuate the INDICATOR RESET switch on the front of the CPU	0	All-black	In-line	In-line
(4) Set S1 to "17" and check that the indicator lamp on test set is not lit	-	-	-	-
(5) Repeat operation (2)	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
(6) Repeat operation (3)	0	All black	In-line	In-line
(7) Set S1 to "18" and check that the indicator lamp on test set is not lit	-	-	-	-
(8) Repeat operation (2)	0	BUSBAR: white	Cross-line after BTB	Cross-line after 2.5(±1.0) s
(9) Repeat operation (3)	0	All black	In-line	In-line
11. Overcurrent Sensing Circuit:				
(1) Set S1 to "19", set S2 and S5 to "2", and then set S4 to "2" NOTE: There is a delay between the operation and the fault display.	0	BUSBAR: white	Cross-line after BTB	Cross-line after 6(±2) s
(2) Set S2, S4 and S5 to "1", select "OFF" and then "ON" (reset) at the GCB control switch, select "RESET" and then "NORM" at the BTB control switch, and actuate the	0	All black	In-line	In-line

OPERATION	INDICATION			
	VOLTS	CPU FAULT IND.	GCB MAG. IND.	BTB MAG. IND.
INDICATOR RESET switch on the front of the CPU				
12. Generator Feeder Fault Circuit:				
(1) Set S1 to "20" and check that the indicator lamp on test set is not lit	-	-	-	-
(2) Set S2 to "2"	0	GENERATOR FEEDER: white	Cross-line	In-line
(3) Set S2 to "1", S1 to "1" and actuate the INDICATOR RESET switch on the front of the CPU, then set 28 V supply switch on test set to "OFF"	0	All black	Cross-line	In-line

Dormant Circuit Test
Table 502

E. Final - Main Engines Running

(1) Prepare

(a) Connect the precision-grade a.c. voltmeter and frequency meter to pins A and B of the a.c. test socket D116-A on panel 18-216.

(b) Ensure that the aircraft power unit installation and systems are cleared and safe for the ground running of all four engines to be carried out (Ref. Chap.71).

(c) Ensure that the IDG fitted to each engine has been cleared for running (Ref. 24-11-11, Inspection/Check) and that the transmission constant speed drive is engaged.

(d) Make available electrical ground power as detailed in 24-41-00, Servicing.

NOTE: The settings/indications of controls and indicators checked at the following operation (3) are those usual upon satisfactory connection of a ground power supply to the main a.c. distribution system (ground power breaker (GPB) closed).

(e) On the electrical generating control panel, ensure that -

e1) the AC FREQ/VOLTS selector switch is set to GRND PWR and that the correct voltage and frequency are indicated on the a.c. voltmeter and frequency meter,

R **ON A/C 007-007,

e2) the battery control switches are at OFF, the associated 'battery isolate' magnetic indicators display cross-line, the DC NORM/SPLIT control switch is at NORM, and the essential/main split indicators display in-line,

R **ON A/C 001-006,

e2) the battery control switches are at BATT OFF, the associated 'battery isolate' magnetic indicators display cross-line, and and essential/main split indicators display in-line,

e3) the SSB control switch is at CLOSE and the SSB position magnetic indicator displays in-line,

e4) Nos.1, 2, 3 and 4 BTB control switches are

at NORM and all four BTB position magnetic indicators display in-line,

e5) all four generator circuit breaker (GCB) position magnetic indicators and the auto shed breaker (ASB) position magnetic indicator display cross-line,

e6) all four essential/main (NORM/EMERG) control switches are at NORM and the associated magnetic indicators display in-line,

e7) all four TRU control switches are at NORM, and

e8) only the captions GRND PWR AVAILABLE, CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and both battery ISOLATE captions are illuminated.

(f) Check that the voltage and frequency of the ground power supply is indicated on the test voltmeter and frequency meter connected at the a.c. test socket.

R **ON A/C 007-007,

(g) In readiness for engine starting, set the battery control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

R **ON A/C 001-006,

(g) In readiness for engine starting, set the battery control switches to "BATT ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(h) Ensure that the emergency generator mode switch is at AUTO.

CAUTION: IF A CSD (CONSTANT SPEED DRIVE) FAILURE CAPTION REMAINS ILLUMINATED AFTER THE ASSOCIATED ENGINE HAS RUN UP TO A SPEED OF 62 PER CENT N2 OR ABOVE, ABNORMAL OPERATION OF THE IDG IS INDICATED. THE CSD DISCONNECT SWITCH MUST THEN BE OPERATED TO THE "DISC" POSITION TO EFFECT DISENGAGEMENT

OF THE IDG TRANSMISSION.

DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

(i) Start and run Nos.1, 2, 3 and 4 engines at a speed above 62 per cent N2, noting the procedures to be carried out if excessive CSD OIL INLET temperature is indicated during the engine run (Ref. 71-00-00). Check that the captions CSD 1, CSD 2, CSD 3 and CSD 4 are extinguished.

(2) Test

(a) Ensure that ground power is fully available -

a1) by checking that the GRND PWR AVAILABLE caption is illuminated, and

a2) by setting the ground power control switch to CLOSE and releasing it.

(b) Set Nos.1, 2, 3 and 4 generator control switches to "OFF" and check that the associated magnetic indicators change to cross-line and the captions GEN 1, GEN 2, GEN 3 and GEN 4 are illuminated.

(c) Set the AC FREQ/VOLTS selector switch to "GEN 1" and check that the voltage and frequency indications on the aircraft meters (i.e., those on the electrical generating control panel) and those on the test meters fall to near zero.

(d) Set and hold No.1 generator control switch at "TEST" and check that -

d1) No.1 GCB magnetic indicator remains cross-line,

d2) the caption GEN 1 remains illuminated,

d3) the correct voltage and frequency, 115(+3 -5) V, 400(±4) Hz, are indicated on the test meters, and

d4) the voltage and frequency indications on the aircraft meters are approximately the same as the indications on the test meters.

(e) Release No.1 generator control switch to "OFF" and check that the voltage and frequency indications on the aircraft meters and the test meters fall to near zero.

(f) Set No.1 generator control switch to "ON" and check that -

f1) No.1 GCB magnetic indicator changes from cross-line to in-line,

f2) the caption GEN 1 is extinguished, and

f3) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(g) Select and switch on such aircraft services as can be used to impose a total load greater than 40 kW but not exceeding 54 kW as indicated on No.1 KW/KVAR meter. Check that -

g1) the correct voltage and frequency, 115(+3 -5) V, 400(±4) Hz, are indicated on the test meters, and

g2) the voltage and frequency indications given on the aircraft meters are consistent with the indications on the test meters.

NOTE: The calibration tolerances for the aircraft a.c. voltmeter and the aircraft frequency meter are as follows:-

AC voltmeter:	Not greater than 5 per cent of the full scale deflection
Frequency meter:	±1 per cent of the full scale deflection

(h) Press No.1 P/ASSIST push-switch and then release it, checking that a rise of approximately 3 Hz is indicated on the test meter while the switch

is pressed.

(i) Set No.1 generator control switch to "OFF" and check that -

i1) No.1 GCB magnetic indicator changes from in-line to cross-line,

i2) the caption GEN 1 is illuminated,

i3) the voltage and frequency indications on the aircraft meters and the test meters fall to near zero, and

i4) the GPB closes, by observing that Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(j) Set the AC FREQ/VOLTS selector switch to "GEN 2".

(k) Set and hold No.2 generator control switch at "TEST" and check that -

k1) No.2 GCB magnetic indicator remains cross-line,

k2) the caption GEN 2 remains illuminated,

k3) the correct voltage and frequency, 115(+3 -5) V, 400(±4) Hz, are indicated on the test meters, and

k4) the voltage and frequency indications on the aircraft meters are consistent with the indications on the test meters.

(l) Release No.2 generator control switch to "OFF" and check that the voltage and frequency indications on the aircraft meters and the test meters fall to near zero.

(m) Set No.2 generator control switch to "ON" and check that -

m1) No.2 GCB magnetic indicator changes from

cross-line to in-line,

m2) the caption GEN 2 is extinguished,

m3) the correct voltage and frequency, 115(±3 -5) V, 400(±4) Hz, are indicated on the test meters,

m4) the voltage and frequency indications on the aircraft meters are consistent with the indications on the test meters, and

m5) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(n) Press No.2 P/ASSIST push-switch and then release it, checking that a rise of approximately 3 Hz is indicated on the test meter while the switch is pressed.

(o) Set No.2 generator control switch to "OFF" and check that -

o1) No.2 GCB magnetic indicator changes from in-line to cross-line,

o2) the caption GEN 2 is illuminated,

o3) the GPB closes, by observing that Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line, and

o4) the voltage and frequency indications on the aircraft meters and those on the test meters fall to near zero.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(p) Set No.1 generator control switch to "ON" and check that -

p1) No.1 GCB magnetic indicator changes from cross-line to in-line,

p2) the caption GEN 1 is extinguished, and

p3) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(q) Set No.2 generator control switch to "ON". Check that No.2 generator comes into parallel operation with No.1 generator, by observing that No.2 GCB magnetic indicator changes from cross-line to in-line and the caption GEN 2 is extinguished. If No.2 generator fails to come into parallel operation with No.1 generator, proceed as follows:-

q1) Identify the generator with the lowest frequency identification by using the AC FREQ/VOLTS selector switch, and then

q2) momentarily press the P/ASSIST push-switch associated with the generator giving the lowest frequency indication.

NOTE: Operation of a P/ASSIST push-switch affects the CSD (IDG transmission) output speed and momentarily increases the generator frequency by approximately 3 Hz. This permits automatic paralleling where previously the generators were either running synchronized but at incorrect phase angle, or their frequency difference was greater than 4 Hz.

(r) Note the reading in kilowatts indicated on Nos.1 and 2 KW/KVAR meters. Check that any difference in load sharing, so indicated, does not exceed 6 kW.

(s) Press the PUSH FOR KVAR push-switch and note the reading on Nos.1 and 2 KW/KVAR meters. Check that any difference in load sharing, so indicated, does not exceed 4 kVAR.

(t) Set No.1 BTB control switch to "TRIP" and check that No.1 BTB opens, by observing that the associated magnetic indicator changes from

in-line to cross-line.

(u) Press-to-release the No.1 PARALLEL PUSH TO ARM push-switch. Check that the switch knob is self-extended and that the paralleling light in the knob cycles 'on' (bright) and 'off' (dim).

NOTE: While the BTB is open and the associated PARALLEL PUSH TO ARM push-switch is extended the paralleling light in the knob cycles 'on' and 'off' at the rate of the difference in frequency between the generators.

(v) When No.1 paralleling light is 'off', set No.1 BTB control switch to "RESET" and then release to "NORM". Check that No.1 BTB closes, by observing that the associated magnetic indicator changes from cross-line to in-line.

NOTE: If necessary, the appropriate P/ASSIST push-switch may be operated to facilitate closure of the BTB.

(w) Press-to-cancel No.1 PARALLEL PUSH TO ARM push-switch and check that the knob is retained in the depressed position.

(x) Repeat operations (t), (u), (v) and (w) as applied to No.2 BTB control switch, magnetic indicator and PARALLEL PUSH TO ARM switch.

(y) Set the AC FREQ/VOLTS selector switch to "GRND PWR".

(z) Set Nos.1 and 2 generator control switches to "OFF" and check that -

z1) Nos.1 and 2 GCB magnetic indicators change from in-line to cross-line,

z2) the captions GEN 1 and GEN 2 are illuminated,

z3) the GPB closes, by observing that Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line, and

z4) the voltage and frequency of the ground

power supply are indicated on the aircraft meters and on the test meters.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(aa) Set the AC FREQ/VOLTS selector switch to "GEN 3" and check that the voltage and frequency indications on the aircraft meters and those on the test meters fall to near zero.

(ab) Set and hold No.3 generator control switch at "TEST" and check that -

ab1) No.3 GCB magnetic indicator remains cross-line,

ab2) the caption GEN 3 remains illuminated,

ab3) the correct voltage and frequency, 115(+3 -5) V, 400(±4) Hz, are indicated on the test meters, and

ab4) the voltage and frequency indications on the aircraft meters are consistent with the indications on the test meters.

(ac) Release No.3 generator control switch to "OFF" and check that the voltage and frequency indications on the aircraft meters and the test meters fall to near zero.

(ad) Set No.3 generator control switch to "ON" and check that -

ad1) No.3 GCB magnetic indicator changes from cross-line to in-line,

ad2) the caption GEN 3 is extinguished,

ad3) the correct voltage and frequency, 115(+3 -5) V, 400(±4) Hz, are indicated on the test meters,

ad4) the voltage and frequency indications on the aircraft meters are consistent with the indications on the test meters, and

ad5) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated

magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(ae) Press No.3 P/ASSIST push-switch and then release it, checking that a rise of approximately 3 Hz is indicated on the test meter while the switch is pressed.

(af) Set No.3 generator control switch to "OFF" and check that -

af1) No.3 GCB magnetic indicator changes from in-line to cross-line,

af2) the caption GEN 3 is illuminated,

af3) the voltage and frequency indications on the aircraft meters and the test meters fall to near zero, and

af4) the GPB closes, by observing that Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(ag) Set the AC FREQ/VOLTS selector switch to "GEN 4".

(ah) Set and hold No.4 generator control switch at "TEST" and check that -

ah1) No.4 GCB magnetic indicator remains cross-line,

ah2) the caption GEN 4 remains illuminated,

ah3) the correct voltage and frequency, 115(+3 -5) V, 400(±4) Hz, are indicated on the test meters, and

ah4) the voltage and frequency indications on the aircraft meters are consistent with the indications on the test meters.

(ai) Release No.4 generator control switch to "OFF" and check that the voltage and frequency

indications on the aircraft meters and the test meters fall to near zero.

(aj) Set No.4 generator control switch to "ON" and check that -

aj1) No.4 GCB magnetic indicator changes from cross-line to in-line,

aj2) the caption GEN 4 is extinguished,

aj3) the correct voltage and frequency, 115(+3 -5) V, 400(±4) Hz, are indicated on the test meters,

aj4) the voltage and frequency indications on the aircraft meters are consistent with the indications on the test meters, and

aj5) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

(ak) Press No.4 P/ASSIST push-switch and then release it, checking that a rise of approximately 3 Hz is indicated on the test meters while the switch is pressed.

(al) Set No.4 generator control switch to "OFF" and check that -

al1) No.4 GCB magnetic indicator changes from in-line to cross-line,

al2) the caption GEN 4 is illuminated,

al3) the voltage and frequency indications on the aircraft meters and the test meters fall to near zero, and

al4) the GPB closes, by observing that Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

NOTE: A momentary illumination of the AC ESS

BUS captions is acceptable.

(am) Set No.3 generator control switch to "ON" and check that -

am1) No.3 GCB magnetic indicator changes from cross-line to in-line,

am2) the caption GEN 3 is extinguished, and

am3) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated indicators remain in-line.

NOTE: A momentary illumination of the AC ESS BUS captions is acceptable.

an) Set No.4 generator control switch to "ON". Check that No.4 generator comes into parallel operation with No.3 generator, by observing that No.4 GCB magnetic indicator changes from cross-line to in-line and the caption GEN 4 is extinguished. If No.4 generator fails to come into parallel operation with No.3 generator, proceed as follows:-

an1) Identify the generator with the lowest frequency indication, by using the AC FREQ/ VOLTS selector switch, and then

an2) momentarily press the P/ASSIST push-switch associated with the generator giving the lowest frequency indication.

(ao) Note the reading in kilowatts indicated on Nos.3 and 4 KW/KVAR meters. Check that any difference in load sharing, so indicated, does not exceed 6 kW.

(ap) Press the PUSH FOR KVAR push-switch and note the reading on Nos.3 and 4 KW/KVAR meters. Check that any difference in load sharing, so indicated, does not exceed 4 KVAR.

(aq) Set No.3 BTB control switch to "TRIP" and check that No.3 BTB opens, by observing that the associated magnetic indicator changes from in-line to cross-line.

(ar) Press-to-release the No.3 PARALLEL PUSH TO ARM

push-switch. Check that the switch knob is self-extended and the paralleling light in the knob cycles 'on' (bright) and 'off' (dim).

(as) When No.3 paralleling light is 'off', set No.3 BTB control switch to "RESET" and then release to "NORM". Check that No.3 BTB closes, by observing that the associated magnetic indicator changes from cross-line to in-line.

NOTE: If necessary, the appropriate P/ASSIST push-switch may be operated to facilitate closure of the BTB.

(at) Press-to-cancel No.3 PARALLEL PUSH TO ARM push-switch and check that the knob is retained in the depressed position.

(au) Repeat operations (aq), (ar), (as) and (at) as applied to No.4 BTB control switch, magnetic indicator and PARALLEL PUSH TO ARM push-switch.

(av) Set the AC FREQ/VOLTS selector switch to "GRND PWR".

(aw) Set No.1 generator control switch to "ON". Check that No.1 generator comes into parallel operation with Nos.3 and 4 generators, by observing that No.1 GCB magnetic indicator changes from cross-line to in-line and the caption GEN 1 is extinguished.

(ax) If No.1 generator fails to come into parallel operation with Nos.3 and 4 generators, press No.1 P/ASSIST push-switch. If this action is ineffective, hold Nos.1, 3 and 4 generator control switches in turn at "TEST" (employing the AC FREQ/VOLTS selector switch to check the generator frequency) and then release to "ON", operating the P/ASSIST push-switch of the generator with the lowest frequency.

R14 (ay) Set No.2 generator control switch to "ON". Check that No.2 generator comes into parallel operation with Nos.1, 3 and 4 generators, by observing that No.2 GCB magnetic indicator changes from cross-line to in-line and the caption GEN 2 is extinguished.

R14 (az) If No.2 generator fails to come into parallel operation with Nos.1, 3 and 4 generators, press

No.2 P/ASSIST push-switch. If this action is ineffective, hold Nos.1, 2, 3 and 4 generator control switches in turn at "TEST" (employing the AC FREQ/VOLTS selector switch to check the generator frequency) and then release to "ON", operating the P/ASSIST push-switch of the generator with the lowest frequency.

R14 (ba) Note the reading in kilowatts indicated on Nos.1, 2, 3 and 4 KW/KVAR meters. Check that any difference in load sharing does not exceed 6 kW.

R14 (bb) Press the PUSH FOR KVAR push-switch and note the reading on Nos.1, 2, 3 and 4 KW/KVAR meters. Check that any difference in load sharing, so indicated, does not exceed 4 kVAR.

R14 (bc) Set the SSB control switch to "OPEN" and check that the SSB magnetic indicator changes from in-line to cross-line.

R14 (bd) Set the SSB control switch to "CLOSE" and check that the SSB magnetic indicator changes from cross-line to in-line.

R14 (be) Where the operation of a P/ASSIST switch has been necessary to bring a generator into parallel operation, record the frequency of each generator as registered on the test meter, by holding Nos.1, 2, 3 and 4 generator control switches, in turn, at "TEST" with the AC FREQ/ VOLTS selector switch set to the corresponding generator position. If a difference in frequency greater than 4 Hz is registered between any two generators, the associated CSD(s) must be adjusted.

<u>NOTE</u>: If CSD (IDG transmission) adjustment is necessary, refer to 24-11-00, Main Generator Drive, Adjustment/Test.

(bf) Disconnect No.1 IDG as follows:-

<u>CAUTION</u>: DAMAGE TO THE DISCONNECT SOLENOID MAY RESULT IF THE CSD DISCONNECT SWITCH IS HELD AT THE "DISC" POSITION FOR MORE THAN 5 s.

bf1) Set the AC FREQ/VOLTS selector switch to the appropriate "GEN" position.

bf2) Set the CSD disconnect switch to "DISC" and then release it to "NORM". Check that the associated CSD caption is illuminated, indicating a loss of charge oil pressure, and hence that the IDG is disconnected.

bf3) Set the associated generator control switch to "TEST" and check that the voltage and frequency indications on the aircraft meters and the test meters fall to near zero; then set the switch to "ON".

bf4) Shut down the associated engine (Ref. 71-00-00).

(bg) Repeat operation (bf), in turn, for No.2 IDG, No.3 IDG and No.4 IDG.

(bh) When all four IDGs have been disconnected, ensure that the GPB has closed, by observing that Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions remain extinguished and the associated magnetic indicators remain in-line.

(3) Conclusion

R **ON A/C 007-007,

(a) Set BATT A and BATT B control switches to "OFF" and ensure that the AC FREQ/VOLTS selector switch is set to GRND PWR.

R **ON A/C 001-006,

(a) Set BATT A and BATT B control switches to "BATT OFF" and ensure that the AC FREQ/VOLTS selector switch is set to GRND PWR.

(b) Switch off and disconnect electrical ground power as detailed in 24-41-00, Servicing.

(c) Disconnect and remove the precision-grade a.c. voltmeter and frequency meter connected at the a.c. test socket.

(d) Reset Nos.1, 2, 3 and 4 IDGs in accordance with the procedure for IDG resetting after disconnection (Ref. 24-11-00, Adjustment/Test).

MAIN A.C. AND DE-ICING CONTACTORS - INSPECTION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS AS DETAILED IN THE MAINTENANCE MANUAL CHAPTER 24-00.

1. Contactor In-Situ Inspection

NOTE: ACCESS TO PANEL 24-215 INVOLVES REMOVAL OF SERVICE TROLLEYS UNDER GALLEY WORKING SURFACE AND DISMANTLING OF GALLEY STRUCTURE (TO EXTENT NECESSARY) AS DETAILED IN MM CHAPTER 25.

A. Refer to MM Chapter 24-00

Page 301. General-Servicing
Page 401. General-Removal/Installation
Page 10. Figure 406 Location of Equipment

MM Chapter 30-11

Page 401. De-icing, Control and Indication-Removal/Installation
Page 402. Figure 401, Location of Equipment

At panels 24-215 and 24-216, gain access to the following contactors in accordance with the relevant MM Chapter requirements ref. Table 601.

PANEL 24-215		PANEL 24-216	
EQUIP IDENT	DESCRIPTION	EQUIP IDENT	DESCRIPTION
X24	Split System Breaker	X25	Split System Breaker
1X6	Bus-Tie Breaker	3X6	Bus-Tie Breaker
2X6	Bus-Tie Breaker	4X6	Bus-Tie Breaker
1X5	Generator Circuit Breaker	3X5	Generator Circuit Breaker
2X5	Generator Circuit Breaker	4X5	Generator Circuit Breaker
1H1843	De-icing Cyclic Control Breaker	2H1843	De-icing Cyclic Control Breaker
		X21	Ground Power Breaker

TABLE 601

B. At each of the above contactors, separately, and in its vicinity, check visually for signs of blistering or discolouration, particularly on the contactor terminal plate, the connecting cable-ends and cable insulation, which might indicate overheating.

B C. At each contactor, remove the terminal cover, then the
RB insulated cover over the contact cavities. Visually
B examine the insulated cover then each main contact cavity,
B for damage, discolouration, sooting or signs which might
B indicate overheating.

RB NOTE: Disassembly is limited to cover removal. The main
RB contacts must not be disturbed during visual
RB inspection of the contact cavity.

B Where the condition cannot be accepted with complete
B confidence, the contactor should be removed for workshop
B testing. Record the findings in respect of each contactor.
B Re-assemble the insulated cover over the contact cavities,
B but not the terminal cover.

B D. At each contactor, and being careful not to disturb the
B 'lay' of the adjoining cables, check the tightening torque
B of each of the six terminal nuts, which must be between 119
B and 121 lbf in (1.35 and 1.48 mdaN). Record the findings
B for each contactor. Re-assemble the terminal cover.

B E. Refit access panels.

DIFFERENTIAL PROTECTION CURRENT TRANSFORMER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The differential protection current transformer units (CTUs) are located near the bottom of panels 24-215, LH (Nos.1 and 2), and 24-216, RH (Nos.3 and 4) at the aft end of the flight compartment equipment racking. Each CTU provides signals to the control and protection unit and load controller in the associated main generation channel.

2. Differential Protection Current Transformer

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 240 to 265 lbf in (2.71 to 2.99 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Gain access to panel 24-215 by removing the service trolleys stowed under the galley working surface and, if necessary, dismantle the galley structure as detailed in Chapter 25. Release the 'quick-thread' studs in the lower access panel and remove the panel.

R (3) Gain access to panel 24-216 by removing the furnishing
R equipment as detailed in Chapter 25.

C. Remove

(1) Disconnect the electrical connector from the transformer.

(2) Release the transformer from the cables passing through the A, B and C core holes by disconnection of the cables from the terminals of adjacent equipment.

NOTE: Note the order of assembly of cable

terminations and clamping washers at the local equipment terminals to ensure correct installation.

(3) Remove the mounting screws and washers, and withdraw the transformer.

D. Install

(1) Comply with the electrical safety precautions.

(2) Place the transformer on its mounting base, with the electrical connector pointing downward, and secure it with the screws and washers. On Nos.1 and 3 transformers, use the two longer screws to secure the transformer electrical cable clips at the end positions on the upper flange of the transformer. By reference to the applicable wiring diagram and the transformer markings (T1 and T2) check that the transformer is correctly orientated. Ensure that the transformer is bonded in accordance with 20-27-11.

CAUTION: CONTACTORS ARE NORMALLY SUPPLIED WITH ONE THICK WASHER, ONE THIN WASHER AND A SPRING WASHER TO EACH TERMINAL POST. THE SPRING WASHER MUST BE PLACED DIRECTLY UNDER THE TERMINAL NUT AND THE THIN WASHER UNDER THE SPRING WASHER. THE THICK WASHER IS NOT REQUIRED.

THE ASSEMBLY ORDER OF BUSBAR/CABLES TO A CONTACTOR TERMINAL POST MUST BE BUSBAR FIRST, IF FITTED, FOLLOWED BY CABLES IN SIZE ORDER WITH THE LARGEST CABLE FIRST.

(3) Pass the electrical cables through the respective A, B and C core holes of the transformer and connect the cables to the terminals of adjacent equipment, ensuring that the routing of the cables through the transformer and the connections to the equipment are made in accordance with the cable identifications and the applicable wiring diagram. Ensure also that the order of assembly of the cable terminations and clamping washers is correct.

(4) Tighten the generator circuit breaker terminal nuts to a torque loading of between 119 and 131 lbf in (1.35 and 1.48 mdaN). Tighten the heavy duty terminal block nuts to a torque loading of between 240 and 265 lbf in (2.71 and 2.99 mdaN).

(5) Connect the electrical connector to the transformer.

E. Conclusion

(1) On panel 24-215, fit the access panel and secure it with the 'quick-thread' studs. If necessary, reassemble the galley structure as detailed in Chapter 25. Stow the servicing trolleys under the galley working surface.

R (2) Fit the furnishing equipment over panel 24-216 as
R detailed in Chapter 25.

(3) Cancel the electrical safety precautions taken in operation B.(1).

(4) Carry out an AC Generation Functional Test - Using Main Engines (Ref. 24-00-00, Adjustment/Test).

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CONTROL AND PROTECTION UNIT - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

The control and protection unit (CP) forms part of the aircraft four-channel, three-phase, main a.c. generation system; one CPU is used in each channel.

2. Description (Ref. Fig. 001)

Each CPU controls the output of its associated integrated drive generator by varying the excitation supply in the generator main-exciter field winding. The excitation supply is provided by a permanent-magnet pilot-exciter in the generator. This supply is controlled by the CPU so as to maintain the average of the generator three-phase line-to-neutral output voltages, at the point of regulation, constant within close limits subject to an overriding limit on the highest phase voltage. This is achieved by varying the ratio of 'on' to 'off' periods of a switching transistor connected in series with the generator main-exciter field; whilst the switching transistor is 'off' a recirculating path is provided for the excitation current.

When the CPUs are effecting control of channels operating in parallel, the excitation of each generator is further controlled by signals from a current transfer loop, so as to equalize the reactive components of current in the generator output, whilst maintaining the same voltage limits as apply to single-channel operation. In addition the CPU provides system protection by controlling -

(1) an internal excitation relay (ER) to enable the generator to be de-excited if a fault occurs, and

(2) the following components of the main a.c. generation system (Ref. 24-21-00).

(a) Generator circuit breaker (GCB).

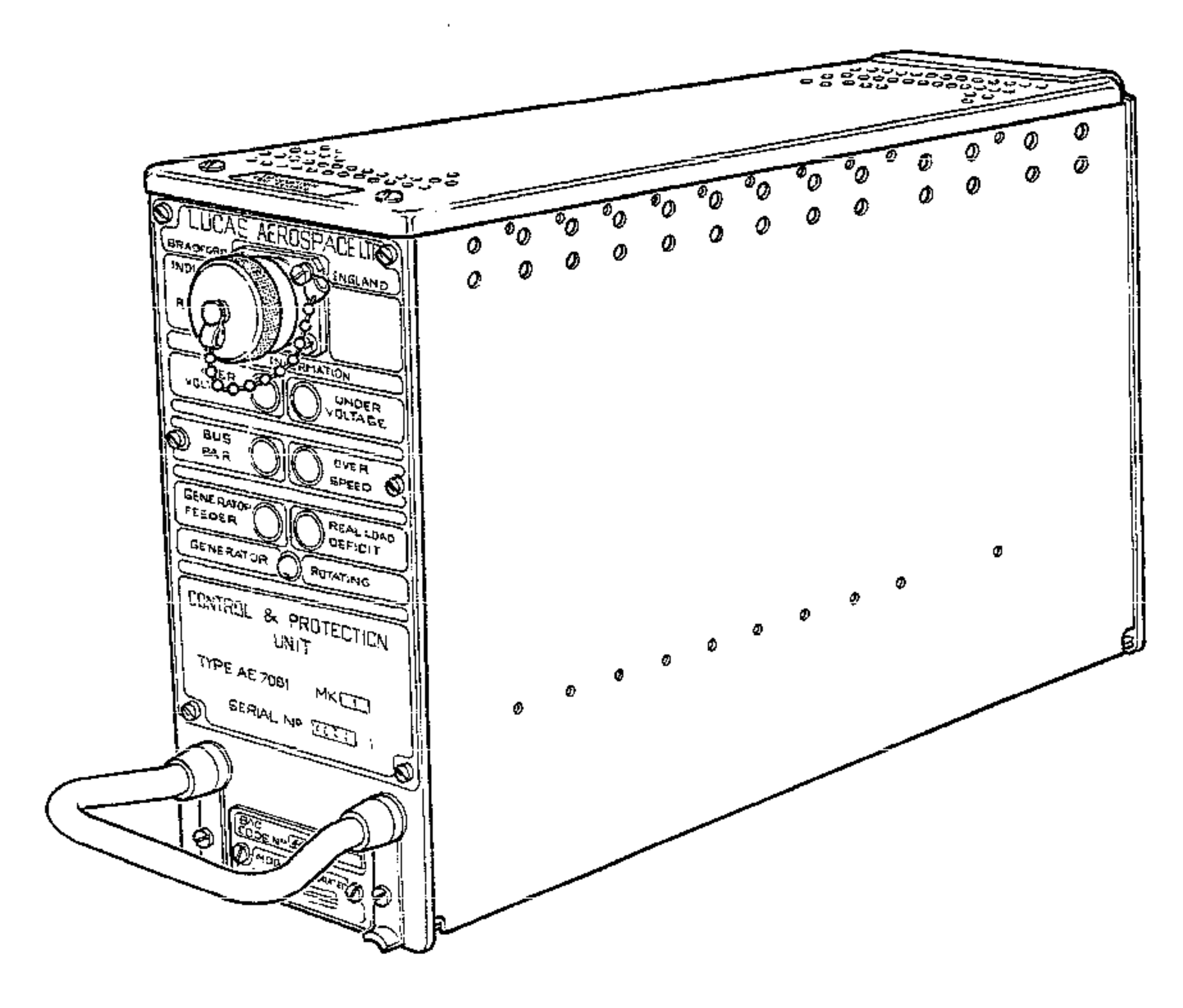
(b) Bus-tie breaker (BTB).

(c) Split system breaker (SSB).

(d) Ground power breaker (GPB).

Protection is provided against overvoltage, overexcitation, undervoltage, underexcitation, overcurrent, current unbalance, differential current, drive overspeed and real load deficit faults.

CB15462/00A



CMB 24 21 21 0 AAM0

Control and Protection Unit
Figure 001

Fault indication is provided, on the front panel, by six latched magnetic indicators, which display 'black' (metallic grey) during normal operation and 'white' to indicate the following faults:-

(1) OVERVOLTAGE

(2) UNDERVOLTAGE

(3) BUSBAR

(4) GENERATOR FEEDER

(5) OVERSPEED

(6) REAL LOAD DEFICIT

All of the above indicators, if activated, must be reset by depressing an INDICATOR RESET microswitch accessible on the front panel.

A light-emitting diode, also on the front panel, labelled GENERATOR ROTATING, is lit when the generator shaft speed exceeds 1,000 rpm.

A test connector, fitted on the front panel, enables in-situ testing of the protective circuits within the CPU to be carried out in conjunction with a suitable test set.

The unit case is of a standard (ATR) rack-mounting type, the majority of the components being mounted on printed circuit boards. Electrical connections are made through a double connector on the rear panel.

3. Operation (Ref. Fig.001 and 002)

A. Power Supplies

(1) Pilot-exciter 1,600 Hz Supply

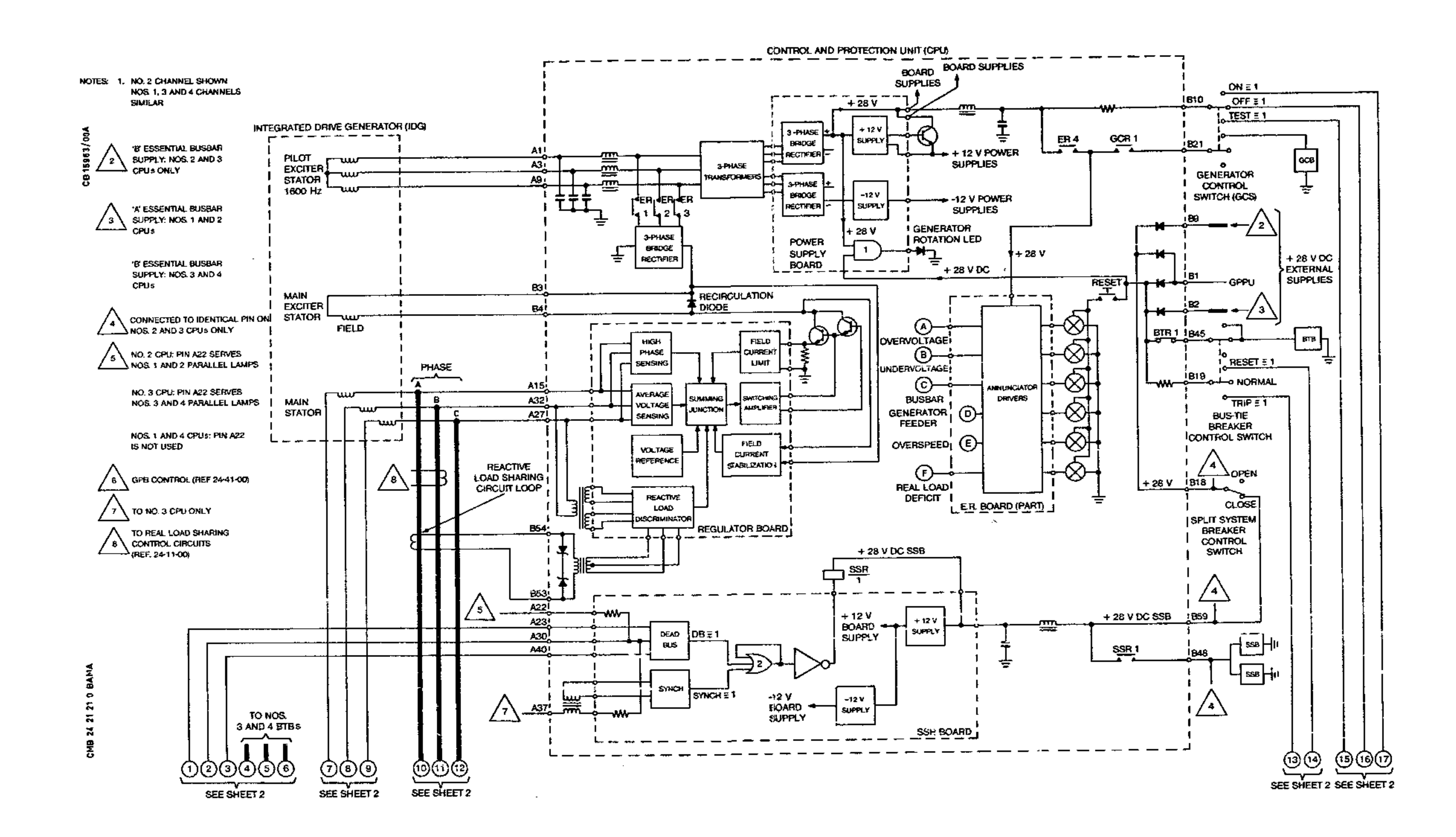
A three-phase, three-wire, 1,600 Hz external supply from the pilot-exciter of the generator under control is accepted by the CPU and applied to normally-open contacts of the excitation relay (ER) and to a set of transformers which provide two three-phase outputs. The transformer outputs are applied to two three-phase bridge rectifiers on a power supply board (PSB) which, in turn, provide +28 V, +12 V and -12 V outputs.

(2) +28 V d.c. Supplies (External)

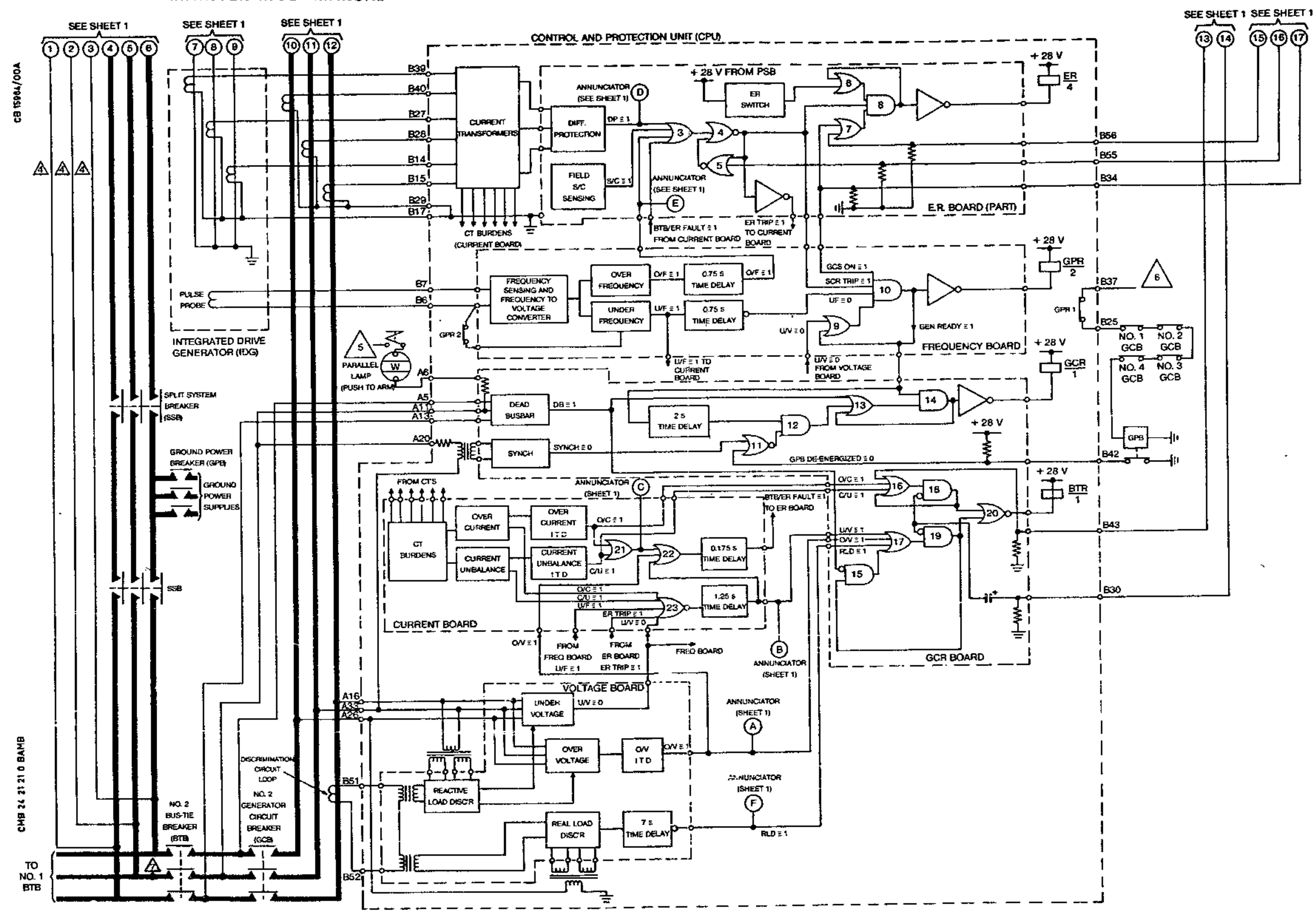
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Simplified Schematic
(Sheet 1 of 2)
Figure 002



Simplified Schematic
(Sheet 2 of 2)
Figure 002

R

Provision is made for the connection of separate +28 V d.c. supplies derived from the aircraft essential supply busbars and/or a ground power supply via the ground power protection unit (GPPU). These supplies are utilized for the energization of the associated BTB and/or SSB to permit -

(a) paralleling of the busbars in all four generation channels with single or combined generator operation, and

(b) connection of a ground power supply to the main a.c. distribution system.

B. Generator Rotation Indication

Indication of rotation of the generator under control at or above 1,000 rpm is provided by a light-emitting diode (LED) which is switched 'on' when the pilot-exciter voltage reaches the level required and a +28 V d.c. external supply is present (AND gate 1).

C. Generator Excitation - Excitation Relay (ER)

The ER control coil is directly connected to the +28 V supply derived from the pilot exciter and control is effected by a three-input AND gate (8) which effects control of the coil return line so as to energize the relay under 'no-fault' conditions as follows:-

(1) When an associated generator control switch (GCS) is set to ON or TEST, a logic 1 signal is thereby applied to a two-input OR gate (7) which, in turn, provides a logic 1 output signal forming one of three inputs to AND gate 8.

(2) A generator differential feeder protection circuit, field short circuit sensing circuit, overfrequency sensing circuit, overcurrent and current unbalance circuits provide logic 0 output signals under 'no fault' conditions to a four-input OR gate (3). The resulting logic 0 output signal provides one input to a two-input NOR gate (4); the gate remains 'off' and provides a second logic 1 input signal to AND gate 8.

NOTE: The second input to NOR gate 4 provides a latching facility when the gate is switched 'on', i.e., by a fault signal from any of the circuits listed above. The latch (designated SCR latch) is provided by a NOR gate (5) and

can be removed only by a GCS OFF (logic 1) input signal; thus ensuring that the generator under control cannot be excited if one or more of the above faults are present and must be manually reselected after a fault has cleared.

(3) When the pilot-exciter voltage of the generator under control is correct, an ER switch produces a logic 1 output signal which provides one input to a two-input OR gate (6); the gate is switched 'on' and produces a logic 1 output signal which provides the third input signal to AND gate 8. The second input to OR gate 6 provides a latching facility when AND gate 8 is switched 'on'; thus inhibiting further control by the ER switch.

With all three inputs to AND gate 8 at 'logic 1' the gate is switched 'on' and the return line to the ER control coil is completed and the relay is energized.

When energized, contacts of the ER -

(1) connect the pilot-exciter output to the main-exciter field via a three-phase bridge rectifier,

(2) enable operation of the fault annunciators, and

(3) complete the supply to the normally-open generator control relay contacts GCR-1, thus arming the generator circuit breaker (GCB) control circuit.

D. Generator Control

(1) Generator Control Relay (GCR)

The GCR control coil is directly connected to the +28 V supply derived from the pilot-exciter, and control is effected by a two-input AND gate (14) which effects control of the coil return line so as to energize the relay under 'no-fault' conditions as follows:-

(a) A dead-bus sensing circuit senses the voltage on the aircraft distribution bus-bars, downstream of the GCB. Provided a dead-bus condition is sensed, a logic 1 signal is applied to a three-input OR gate (13) and to a bus-tie relay (BTR) control circuit (Ref. para.F.).

(b) A synchronization circuit senses the difference between phase B of the generator output and

phase B of the supply on the aircraft distribution bus-bar, downstream of the GCB. Provided the frequency and phase angle do not differ by more than 5 Hz and 90 deg respectively and the difference in voltage is less than 10 V r.m.s., an auto-paralleling signal (logic 0) is produced and applied to a two-input NOR gate (11).

b1) The second input to NOR gate 11 is controlled by contacts of the aircraft ground power breaker (GPB). These contacts apply a logic 1 signal when the GPB is energized and a logic 0 signal when it is de-energized, to ensure that the generator output cannot be paralleled with the ground power supply. When the auto-paralleling signal (logic 0) and GPB de-energized signal (logic 0) are present, NOR gate 11 is switched 'on' and a logic 1 output signal is produced.

b2) This signal is applied to a two-input AND gate (12). The second input to this gate is a 'generator ready' signal (logic 1) received from the frequency sensing circuits when AND gate 10 is switched 'on' (Ref. para.E.). A 2 s delay is imposed on this input to allow synchronizing conditions to stabilize. After this delay has elapsed AND gate 12 is switched 'on' and produces an alternative logic 1 signal input to OR gate 13.

On receipt of either the dead-bus signal (single-channel operation) (logic 1) or the auto-paralleling signal delayed by the 2 s delay (logic 1), OR gate 13 is switched 'on' and produces a logic 1 output signal; thus it will be seen that the 2 s delay is not imposed on the GCR during single-channel operation.

The logic 1 signal from OR gate 13 is applied to the two-input AND gate (14). The other signal to the gate, 'generator ready' (logic 1) having been previously applied by AND gate 10 (Ref. para.E.), enables the gate to be switched 'on'. The return line to the GCR coil is completed and the relay is energized. In addition, the logic 1 output from AND gate 14 is applied to OR gate 13 which is then latched to inhibit further control by the auto-paralleling and dead-bus sensing circuits; thus subsequently only the removal of the generator ready signal (logic 0) will effect control of AND gate 14.

When energized, contacts of the GCR apply a +28 V supply, via the GCS 'ON' position, to energize the GCB.

Generator control applies as above with the GCS at TEST, except that at this setting the switch -

(a) prevents energization of the GCB by interruption of the coil supply, and

(b) removes the logic 1 output that is applied to AND gate 10 by the GCS at ON, thus inhibiting the 'generator ready' signal (Ref. para.E.).

(2) Frequency Control

The output speed of the generator under control is determined by a pulse probe which provides an output signal proportional to the generator shaft speed. This signal is accepted by the CPU and used to sense overfrequency and underfrequency of the generator output and provide the necessary control of the -

(a) ER (Ref. para.C.),

(b) bus-tie relay (Ref. para.F.), and

(c) ground power relay (Ref. para.E.).

(3) Voltage Control

Provided the excitation relay ER is energized (Ref. para.C.), a voltage regulation circuit (voltage board) controls the generator voltage by controlling the pilot-exciter output to the main-exciter field. The generator output and the regulator are connected as a feedback control system to provide voltage control as follows:-

(a) High Phase and Average Voltage Sensing

a1) The generator output is applied to high phase and average voltage sensing circuits. These circuits operate so as to maintain the average of the three line-to-neutral voltages, at the point of regulation, within the limits of 113 to 116 V r.m.s., provided the highest line-to-neutral voltage is not greater than 126 V r.m.s. (Ref. para.a4)).

a2) The outputs of both circuits are monitored and combined with a negative voltage supplied by a voltage reference circuit; the combined signal is then applied to a summing junction.

a3) A differential amplifier monitors the junction inputs and when the input signal level exceeds a preset level a negative output is produced. Conversely a decrease in the input signal level produces a positive output. The differential amplifier output is therefore a negative or positive pulse, with the pulse width dependent upon the duration of the input signal. The amplifier output is applied to a switching amplifier which, in turn, controls power transistors connected in series with the main-exciter field. The transistors are switched 'off' or 'on' to control the field current, the 'on' time being determined by the pulse width of the switching amplifier output.

a4) If the highest phase voltage exceeds 126 V r.m.s. the power transistors are switched 'off' as described in paragraph a3), above.

a5) A recirculation diode is connected in the main-exciter field circuit to provide a path for the excitation current when the transistors are switched off.

(b) Reactive Load Sharing

In parallel operation with associated generator channels, load-sharing circuits monitor the load in each phase of the generator under control and a reactive load discriminator circuit varies the excitation current in the generator main-exciter field in response to the reactive component of a difference current signal in phase A.

The voltage output of the discriminator circuit is proportional to the reactive load difference between the generator under control and the average of all generators in parallel. If the generator under control is taking a lesser share of the reactive load than the other generators, the discriminator output becomes more positive.

Conversely, if the generator share of the load is too high the discriminator output becomes more negative. The output from the discriminator is applied to the summing junction to effect control of the generator main-exciter field as previously described in paragraph (a)a3).

(c) Field Current Limit

A field current limit circuit senses the voltage across a resistor connected in series with the generator main-exciter field.

An increase in field current increases the voltage across the resistor. The voltage is sensed by the current limit circuit and a control signal is applied to the summing junction to effect control of the generator main-exciter field as previously described in paragraph (a)a3).

(d) Field Current Stabilization

A field current stabilization circuit senses the current in a main-exciter field current feedback loop. The output from the stabilization circuit is applied to the summing junction to effect control of the generator main-exciter field as previously described in paragraph (a)a3).

(e) Overexcitation Protection

Excitation protection signals are produced by combining d.c. signals from the undervoltage and overvoltage circuits, proportional to the average of the generator line-neutral (L-N) voltages, with the d.c. signal proportional to the reactive component of the phase C current difference signal. The effect of a feeder current exceeding the average by 5.1(±0.5) A r.m.s. is the same as that of an increase in generator output voltage of 1 V r.m.s. (The effect of a feeder current being below the average by 5.1(±0.5) A r.m.s. is the same as that of a decrease in generator output voltage of 1 V r.m.s.) An overexcitation fault signal is generated if the combined signal exceeds the level corresponding to an average generator output voltage of 128.5(±1.5) V r.m.s., with no reactive-current difference, for a time varying

inversely with the amount of the excess.

In single channel operation, the overexcitation protection is purely overvoltage protection. The main generator output is applied to voltage board circuits which sense the average voltage level. When the voltage is within limits, the overvoltage inverse time delay (ITD) is inhibited. The output of the time delay, logic 0, is distributed as follows:-

e1) To OR gate 22 in the BTB to ER time delay circuit (Ref. para.I.(1)(e) and (f)).

e2) To OR gate 17 (Ref. para.F.).

e3) To the overvoltage driver circuit on the ER board. The output of the driver, logic 0, is applied to inhibit operation of the OVERVOLTAGE annunciator.

In an overvoltage condition the voltage sensed increases. The magnitude of the overvoltage determines the length of the inverse time delay; the higher the overvoltage the shorter the delay. At the end of the time delay a logic 1 output signal is distributed to OR gate 17, to OR gate 22 and to the overvoltage driver circuit, to initiate tripping of the BTR and after a delay the ER, and to effect OVERVOLTAGE annunciation in the manner and with the results detailed in paragraph I.(1)(f).

In parallel operation, if the feeder current is above the average by the amount specified, the voltage output of the reactive load discriminator circuit increases. The increased output is applied to the overvoltage detection circuit, where it has the same effect as an overvoltage condition.

(f) Underexcitation Protection

An underexcitation fault signal is generated if the combined signal (i.e., average of the generator L-N voltages and reactive component of phase C current difference signal) remains below the level corresponding to an average generator output voltage of 100.5(±1.5) V r.m.s., with no reactive current difference, for not less than 1.25(±0.25) s.

In single channel operation the underexcitation protection is purely undervoltage protection. The average generator output voltage level is sensed by the voltage board circuits. When the voltage is within limits the output logic 1 is distributed as follows:-

f1) To OR gate 9 on the frequency board, to enable initiation of the generator ready signal (Ref. para.E.).

f2) To NOR gate 23, which inhibits operation of the undervoltage time delay circuit.

The inputs to NOR gate 23 are as follows:-

f1) No Current Unbalance, logic 0.

f2) Not Overcurrent, logic 0.

f3) Not Undervoltage, logic 1.

f4) No ER trip, logic 0.

f5) Not Underfrequency, logic 0.

Under no-fault conditions the output of NOR gate 23, at logic 0, inhibits the undervoltage time delay circuit. The output of the time delay circuit (logic 0) is distributed as follows:-

f1) To OR gate 22, in the BTB to ER time delay circuit.

f2) To OR gate 17 (Ref. para.F.).

f3) To the undervoltage driver circuit on the ER board. The output of the driver inhibits operation of the UNDERVOLTAGE annunciator.

If the voltage falls below the specified limits, it is sensed by the voltage board circuits and the output changes to logic 0. The logic 0 signal is distributed as follows:-

f1) To OR gate 9 on the frequency board; the signal does not affect the generator ready signal, OR gate 9 having been previously latched on by the output of AND gate 10 (Ref. para.E.).

f2) To NOR gate 23, which changes state to logic 1 output.

NOTE: A current unbalance fault, overcurrent fault, ER trip condition or underfrequency fault will apply a logic 1 signal to NOR gate 23, thereby inhibiting the undervoltage signal.

The logic 1 signal activates the undervoltage time delay circuit, which produces a logic 1 output after a delay of 1.25 s. The logic 1 output is distributed to OR gate 17, to OR gate 22 and the undervoltage driver circuit to initiate tripping of the BTR and, after a delay, the ER and to effect UNDERVOLTAGE annunciation in the manner and with the results detailed in paragraph I.(1)(e).

During parallel operation, if the feeder current falls below the average by more than the specified limit, then the voltage output of the reactive load discriminator circuit will decrease and the circuit will operate as for an undervoltage condition.

E. Ground Power Relay (GPR) Control

The GPR coil is directly connected to the +28 V supply derived from the pilot-exciter and control is effected by a four-input AND gate (10), which effects control of the coil return line so as to energize the relay under 'no-fault' conditions as follows:-

(1) A logic 0 output from the underfrequency circuit is applied to a 0.75 s time delay circuit and inverted to provide a logic 1 output to AND gate 10. Provided the other three inputs (undervoltage, via a two-input OR gate (9), GCS ON and SCR (trip)) are at logic 1, AND gate 10 is activated and produces a logic 1 output that is applied to a drive amplifier and inverter, which completes the GPR coil return line. In addition, the same logic 1 output -

(a) provides a 'generator ready' control signal to AND gate 14 in the GCR relay control circuit, and

(b) latches OR gate (9) 'on', i.e., subsequent undervoltage faults will not trip the GPR.

(2) When energized, contacts of the GPR open -

(a) to de-energize the aircraft distribution ground power breaker (GPB), and

(b) to provide a frequency differential between the correct generator drive speed signal of 3,813 Hz and the underfrequency level of 3,713 Hz.

(3) With the GCS at TEST, energization of the GCB is prevented and the 'generator ready' signal from AND gate 10 is inhibited (Ref. para.D.(1)). With no 'generator ready' signal from AND gate 10, the GPR is de-energized, permitting the GPB to be energized if no other GCB is energized.

NOTE: With no 'generator ready' signal applied to AND gate 14, the GCR is de-energized also but has no effect on the state of the GCB because the GCB coil circuit is already interrupted by the TEST selection at the GCS.

F. Bus-tie Relay (BTR)

The BTR coil is directly connected to the +28 V supply derived from the pilot-exciter and energization is effected by a two-input NOR gate (20), which effects control of the coil return line to de-energize the BTR under 'no-fault' conditions, as follows:-

(1) A current unbalance circuit and an overcurrent circuit produce logic 0 outputs under 'no-fault' conditions to provide two inputs to a four-input OR gate (16). A third input, 'bus-tie trip not selected' (logic 0), is present when the bus-tie breaker control switch is in the NORMAL position. The fourth logic 0 input is received from gate 18 in the 'off' state (subsequent activation of gate 18 provides a logic 1 output which latches gate 16 in the 'on' condition). With all four inputs to OR gate 16 at logic 0 the output signal (logic 0) from gate 16 provides one input to gate 18, which is a two-input AND gate. The gate 18 second input, 'bus-tie breaker reset not selected' (logic 1), is present when the bus-tie breaker control switch is in the NORMAL position. With both inputs at logic 0, gate 18 remains 'off' and provides a logic 0 to NOR gate 20.

(2) Undervoltage, overvoltage and real load deficit sensing circuits, and a dead-bus latching circuit pro-

duce logic 0 outputs under 'no-fault' conditions. These outputs provide input signals to a four-input OR gate (17). The dead-bus is sensed downstream of the GCB and the resulting logic signal is routed via a two-input AND gate 15 so as to provide a latching facility for gate 17. This latch maintains gate 17 in the 'on' condition (as effected by a fault condition) by activation of the two-input AND gate 19. When all four inputs to gate 17 are at logic 0, a logic 0 output signal from the gate provides one input to the two-input AND gate (19). The second input, 'bus-tie breaker reset not selected' (logic 0), is present when the bus-tie breaker control switch is at the NORMAL position. With both inputs at logic 0, gate 19 remains 'off' and a logic 0 output signal from gate 19 provides a second input to NOR gate 20.

When both inputs to NOR gate 20 are at logic 0, the gate applies a logic 1 signal to de-energize the BTR. Contacts of the relay complete a +28 V supply line, via the bus-tie breaker control switch at NORMAL, to energize the system bus-tie breaker (BTB).

G. Split System Relay (SSR) Control

The SSR coil is directly connected to the +28 V supply and energization of the relay is effected by a three-input, latched, OR gate (2), which effects control of the coil return line to energize the SSR under 'no-fault' conditions as follows:-

(1) A dead-bus sensing circuit, sensing downstream of the BTB, produces a logic 1 output when the aircraft busbars to be paralleled are 'dead'. This signal provides an input to gate 2.

(2) A synchronizing sensing circuit produces a logic 1 signal output when the supply on the sub-system busbars to be paralleled is within 5 Hz and 90 deg of the supply on the other sub-system busbars. This signal provides an alternative input to gate 2.

(3) With either input to gate 2 at logic 1 the output from the gate is also logic 1. This signal is returned to gate 2, to latch the gate 'on', and to an inverter which, in turn, energizes the SSR by completing the coil return line. Contacts of the SSR complete the supply lines to the split system breakers (SSBs) and, provided the +28 V supply is available and the SSB switch is set to CLOSE, both SSBs are energized.

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H. Differential Current, Overcurrent and Current Unbalance Protection

(1) Sensing Transformers

Three current transformers (CTs) in the generator and three in the generator feeder current transformer unit (CTU) provide signal currents proportional to the currents in all phases of the generator neutral connections and of the generator main feeders. The differential CT loops are fed to centre-tapped transformers (CTs) in the CPU. The transformer centre-tappings are fed to the differential protection sensing circuits; the output of the secondaries is applied to bridge rectifiers incorporated in the over-current and current unbalance sensing circuits. Associated circuit functions are as follows:-

(a) Differential Current Protection

The differential protection sensing circuit comprises three current burden resistors, a differential amplifier and associated components. When the differential currents are less than fault level, the output of the differential amplifier is at logic 0.

If the current in any phase of the generator neutral connection differs from the current in the same phase of the main line feeder at the GCB by more than 55(±5) A r.m.s., a voltage proportional to the differential amplifier then produces an output at logic 1 which is applied to initiate GENERATOR FEEDER fault annunciation and ER trip in the manner and with the results detailed in paragraph I.(1)(a).

(b) Overcurrent and Current Unbalance Protection

The bridge rectifiers (Ref. para.(1)) develop voltages across burden resistors. The highest and lowest voltage inputs, proportional to the greatest and least phase currents, are sensed by circuits which detect the difference between the greatest and least phase currents (current unbalance) and the highest phase current (overcurrent).

When the feeder currents are within limits, the over-current and current unbalance sensing circuits produce logic 0 outputs which enable

energization of the ER and GCR (Ref. paras.C. and D.) and de-energization of the BTR (Ref. para.F.).

An overcurrent fault signal is generated if any of the current signals remain at a level corresponding to a feeder current of not less than 415(±20) A, for a time governed by the magnitude of the error. A current unbalance fault signal is generated if the difference between the current signals of any two phases remains at a level of not less than 150(±10) A r.m.s. between the currents in the corresponding feeder for a period governed by the magnitude of the error.

If an overcurrent or current unbalance fault signal is generated as above, the sensing circuit applies logic 1 outputs as follows:-

b1) To NOR gate 23 to inhibit the undervoltage signal.

b2) To OR gate 16 to initiate energization of the BTR and effect de-energization of the BTB (Ref. para.I.(3)(a)).

b3) To OR gate 21, which changes state and applies a logic 1 output to effect display of the BUSBAR annunciator, and to OR gate 22, which changes state and applies a logic 1 output via a 175 ms time delay circuit to OR gate 3 to effect tripping of the ER (Ref. para.I.(1)(d)).

I. Fault Conditions

(1) ER Trip - Generator Main-exciter Field De-energized

(a) Differential Feeder Current Fault

If a differential feeder current fault is sensed (Ref. para.H.(1)(a)), the sensing circuit applies a logic 1 signal to effect display of the GENERATOR FEEDER fault annunciator, and to OR gate 3 on the ER board. In consequence -

a1) OR gate 3 changes state and applies a logic 1 signal to NOR gate 4. The resulting logic 0 signal from this gate is applied as follows:-

To NOR gate 5 which changes state and applies a 'latching' logic 1 signal to NOR gate 4; NOR gate 4 remains latched until the state of NOR gate 5 is changed by manually applying a logic 1 input to the gate from the GCS switch OFF position.

To AND gate 8 which changes state and initiates de-energization of the ER coil and removes the 'latch' from OR gate 6.

To AND gate 10 on the frequency board to initiate de-energization of the GPR (Ref. para.(4)), and the GCR relay (Ref. para.(2)).

After inversion to logic 1, to NOR gate 23 on the current board to inhibit operation of the gate (Ref. para.D.(3)(f)).

a2) In consequence -

contacts of the de-energized ER interrupt the pilot-exciter supply to the main-exciter field and the +28 V supply to the GCS switch and the fault annunciators' driving circuit. The generator is de-excited, operation of the remaining fault annunciators is inhibited and the GCB is de-energized.

(b) Field Short Circuit Fault

If a field short circuit (S/C) fault is sensed the sensing circuit applies a logic 1 signal to OR gate 3. The gate changes state and initiates de-energization of the ER as previously described in paragraphs a1) and a2).

(c) Overfrequency Fault

If an overfrequency fault is sensed the sensing circuit applies a logic 1 signal, via a 0.75 s delay circuit, to the OVERSPEED annunciator and to OR gate 3. The gate changes state and initiates de-energization of the ER, as previously described in paragraphs a1) and a2), and the OVERSPEED fault annunciator is displayed.

(d) Current Faults (Overcurrent or Current Unbalance)

If an overcurrent or current unbalance fault is sensed, a fault signal is generated after an inverse time delay. In consequence, the BTB is tripped and the BUSBAR annunciator is displayed (Ref. para.H.(1)(b)). If the fault persists, a logic 1 signal from gate 22 is applied, via a 175 ms time delay, to OR gate 3 (Ref. para. H.(1)(b)). OR gate 3 changes state and initiates de-energization of the ER as previously described in paragraphs a1) and a2).

NOTE: The 175 ms time delay ensures that the BTB is tripped prior to the tripping of the ER, i.e., the channels are 'split' before sensing to avoid healthy channels being tripped off line. Thus, if the fault is removed by the tripping of the BTB, then tripping of the ER and GCB will not occur. The BTB can be reset manually.

(e) Undervoltage/Reactive Load Fault

If an undervoltage/reactive load fault is sensed (Ref. para.D.(3)(f)), the sensing circuit applies a logic 0 signal to NOR gate 23 on the current board. Provided an overcurrent, current unbalance, underfrequency or ER trip signal is not present, gate 23 changes state and after a delay of 1.25 s a logic 1 signal is applied to the UNDERVOLTAGE annunciator, OR gate 17 on the GCR board to effect tripping of the BTB (Ref. para.(3)) and OR gate 22. Gate 22 changes state and applies a logic 1 signal, via a 175 ms delay, to OR gate 3. The gate changes state and initiates de-energization of the ER, as previously described in paragraphs a1) and a2), and the UNDERVOLTAGE annunciator is displayed.

NOTE: If the fault is removed by the tripping of the BTB, then tripping of the ER and GCB will not occur. The BTB can be reset manually.

(f) Overvoltage/Reactive Load Fault

If an overvoltage/reactive load fault is sensed (Ref. para.D.(3)(e)), the sensing circuit applies a logic 1 signal -

f1) to OR gate 17 which changes state and initiates energization of the BTR to effect

tripping of the BTB (Ref. para.(3)),

f2) to the OVERVOLTAGE annunciator, and

f3) to OR gate 22 which changes state and after a delay of 175 ms applies a logic 1 signal to OR gate 3.

OR-gate 3 changes state and initiates de-energization of the ER, as previously described in paragraphs a1) and a2), and the OVERVOLTAGE fault annunciator is displayed.

NOTE: If the fault is removed by the tripping of the BTB, then tripping of the ER and GCB will not occur. The BTB can be reset manually.

(2) GCR Trip - Generator Circuit Breaker (GCB) De-energized

If the 'generator ready' signal (logic 1) changes state (Ref. para.4.), AND gate 14 changes state and applies a logic 0 signal -

(a) to OR gate 13 which removes the latch from gate 14, and

(b) to the GCR coil control circuit to initiate de-energization of the GCR.

The GCR is de-energized and contacts of the relay interrupt the +28 V supply to the GCB which, in turn, is de-energized.

(3) BTR Trip - Bus-tie Breaker (BTB) De-energized

(a) If the bus-tie breaker control switch is set to TRIP (logic 1) or an overcurrent or current unbalance is sensed (logic 1), OR gate 16 changes state and applies a logic 1 signal to AND gate 18. Gate 18 changes state and applies a logic 1 signal to gate 16, which is then 'latched', and to NOR gate 20. Gate 20 changes state and initiates energization of the BTR, or -

(b) if a sustained undervoltage, overvoltage or real load deficit fault is sensed, the associated annunciator UNDERVOLTAGE, OVERVOLTAGE or REAL LOAD DEFICIT is activated and a logic 1 signal is applied to OR gate 17. Gate 17 changes state and

applies a logic 1 signal to AND gate 19 which, in turn, changes state and applies a logic 1 signal to NOR gate 20 and AND gate 15. Gate 20 changes state and initiates energization of the BTR. Gate 15, provided a 'live-busbar' signal is present, changes state and latches gate 17 'on'.

(c) Contacts of the energized BTR interrupt the supply to the BTB coil and the BTB is de-energized.

(d) In order to de-energize the BTR and re-energize the BTB the latch signals from gates 18 or 19 must be removed. This is achieved by applying a logic 1 signal to each gate via the bus-tie breaker control switch RESET position.

(e) If, however, a BTB trip was caused by under-voltage, overvoltage or real load deficit, a subsequent dead-bus (generator 'off') signal applied to gate 15 initiates removal of the latch on gate 17 input, permitting the BTB to be re-energized automatically.

(4) GPR Trip - Ground Power Breaker (GPB) Energized

If the GCS switch is set to OFF or TEST, the SCR latch is tripped or an underfrequency fault is sensed, a logic 0 signal is applied to AND gate 10. The gate changes state and removes the 'generator ready' signal from the GCR board (Ref. para.(2)), initiates de-energization of the GPR relay and applies a logic 0 signal to OR gate 9, which removes the inhibit on the undervoltage signal to AND gate 10.

If the GCBs of all other channels are de-energized, contacts of the de-energized GPR complete the +28 V supply line to the GPB coil and the GPB is energized. Contacts of the energized GPB apply a logic 1 input to NOR gate 11, on the GCR board, to inhibit energization of the GCR (Ref. para.D.(1)((b)).

J. SSR Trip - SSBs De-energized

The SSR is manually de-energized by removing the +28 V supply from the SSR coil. This is accomplished by setting the SSB switch to the OPEN position.

Contacts of the de-energized SSR inhibit operation of the SSBs.

K. Real and Reactive Load Discrimination

(1) General

Two current transformer loops provide current difference signals to the CPU. In each loop a current transformer (CT) contained in the generator feeder current transformer unit (CTU) is linked with the corresponding CTs in the other channels in the system. When the channels are operated in parallel, one loop provides a signal current proportional to the difference between the current in phase C of the generator main feeder of the channel containing the CPU and the average of the currents in phase C of the generator feeders of all the channels in the parallel combination.

NOTE: A second CT loop provides a similar current signal for phase A, which is applied to the voltage regulation circuits (Ref. para.D.(3)). A third CT loop provides a current signal for phase B, which is applied to real load sharing control circuits incorporating a load controller (Ref. 24-11-00).

(2) Real Load Discriminator

The real load discriminator extracts the real component of the phase C current difference signal by gating the current signal with the in-phase voltage. During parallel operation, the voltage output is proportional to any real load difference. When the real load deficit is less than the trip limits, a logic 1 signal inhibits a delay circuit. The resulting output of the delay circuit, logic 0, is applied to OR gate 17 on the GCR board and to the real load deficit annunciator driver circuit.

The output of the driver circuit, logic 0, inhibits the REAL LOAD DEFICIT annunciator.

If a deficit in real load current, in a feeder, of not less than 52(±6) A r.m.s. is sensed, the sensing circuit applies a logic 0 signal to the delay circuit. After a delay of 7 s the delay output changes state to logic 1. This signal is applied to OR gate 17 and to the real load deficit annunciator driver circuit. Gate 17 changes state to initiate energization of the BTR relay (Ref. para.I.(3)(b)) and the REAL LOAD DEFICIT annunciator is displayed.

(3) Reactive Load Discriminator

The operation of the reactive load discriminator circuit is identical with that of the real load discriminator circuit (Ref. para.(2)). The circuit produces an output signal proportional to the reactive load current difference between one phase of the channel and the average local current of the corresponding phases of all paralleled channels. The output signal is combined with the undervoltage and overvoltage protection circuit signals (Ref. paras.I.(1) (e) and (f)).

L. Parallel Lamp

In each channel a parallel lamp is provided to assist manual paralleling, using the bus-tie breaker control switch (Ref. 24-21-00). Each lamp is connected between the phase B tie busbar voltage signal input pin and the phase B load busbar voltage signal input pin of the appropriate CPU via dropping resistors.

CONTROL AND PROTECTION UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Nos.1, 2, 3 and 4 control and protection units (CPUs) are each contained in a standard ATR case mounted in the flight compartment racking on shelves 2-215, 1-215, 1-216 and 2-216 respectively. The front of each case incorporates a handle, to facilitate the removal and installation, and two hold-down lugs; two associated screw assemblies attached to the shelf secure the CPU to its mounting. Electrical connections are made through a double connector at the rear of the CPU.

The following removal and installation procedures apply to any one of the four CPUs.

2. Control and Protection Unit

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

CAUTION: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/INSTALLATION PROCEDURES.

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Trip the SSB CONT circuit breaker and the appropriate GEN CONT UNIT SUP circuit breaker listed below, and fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
SSB CONT	3-213	X29	G12
No.1 GEN CONT UNIT SUP	1-213	1X4	P7

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
No.2 GEN CONT UNIT SUP	1-213	2X4	P8
NO.3 GEN CONT UNIT SUP	3-213	3X4	E8
NO.4 GEN CONT UNIT SUP	3-213	4X4	E9

C. Remove

(1) Gain access to the CPU by removing the appropriate panel from the flight compartment racking.

(2) Ensure that the GENERATOR ROTATING indicator lamp on the front of the CPU is not lit.

(3) Loosen the two clamp nuts and disconnect the screw assemblies from the CPU hold-down lugs.

(4) Withdraw the CPU from the junction box and shelf.

RB (5) Examine rack and unit connectors for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket
RB contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising
RB posts and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

D. Install

(1) Comply with the electrical safety precautions.

RB (2) Examine unit connector for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket
RB contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising
RB posts and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

(3) Place the CPU on the shelf and slide it back until the electrical connectors are fully engaged with the mating connectors of the shelf junction box. Ensure that the CPU is bonded in accordance with 20-27-11.

(4) Engage the two hold-down screw assemblies with the CPU hold-down lugs and secure the clamp nuts.

E. Conclusion

(1) Refit and secure the panel to the flight compartment racking.

(2) Remove the safety clips and reset the circuit breakers tripped before removal.

(3) Carry out a Main Generation Dormant Circuits Functional Test for the associated generation channel (Ref. 24-00-00, Adjustment/Test). Alternatively, i.e., if a dormant Circuit Test Set is not available, carry out an AC Generation Functional Test - Using Main Engines (Ref. 24-00-00, Adjustment/Test).

EMERGENCY AC GENERATION - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

**ON A/C 001-005,
(Ref. Fig. 002)

R **ON A/C 006-007,
(Ref. Fig. 003)

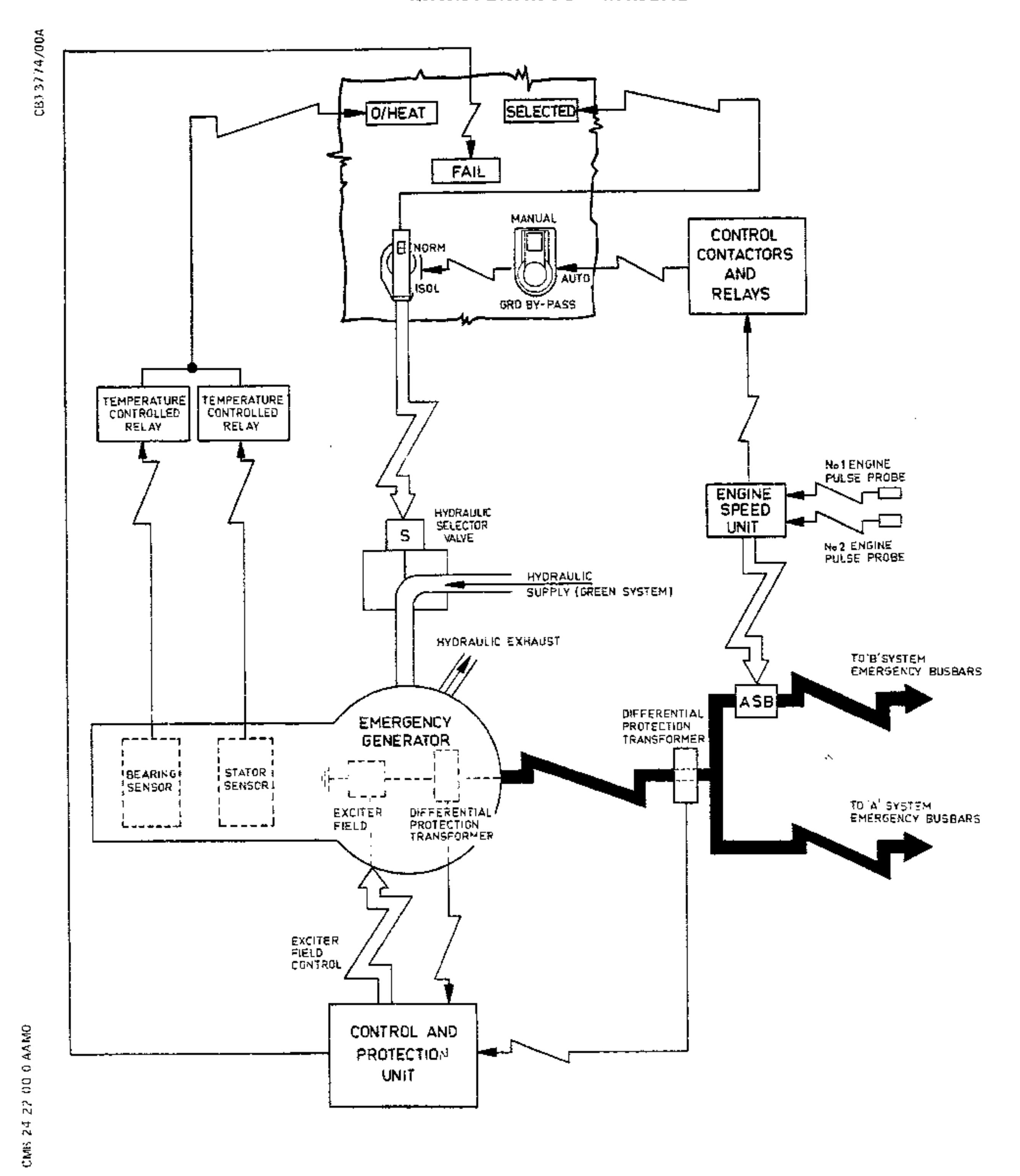
Emergency electrical power of 115/200 V three-phase 400 Hz a.c. is derived from a hydraulically-driven three-phase 30 kVA emergency generator which is available to maintain essential electrical services if normal supplies fail.

A variable-displacement hydraulic motor supplied by the green hydraulic system drives the generator at a constant 8,000 rpm (Ref. 24-12-00). The generator and drive motor are connected by a mounting interface and form a complete unit. The unit is controlled by a solenoid-operated hydraulic selector valve which, in turn, is controlled by automatic circuits or by selective switching.

A pulse probe sensor in each engine provides engine speed signals for an engine speed unit, which is also associated with engine starting (Ref. Chap.80). The engine speed unit monitors the frequency of signals from the four engine-mounted pulse probe sensors and initiates emergency generator operation and effects automatic load shedding, through the operation of an auto shed breaker (ASB), if both No.1 and No.2 engine speeds fall below a predetermined level.

Emergency generation control is normally automatic, but other manually selected modes of operation are available. A control and protection unit (CPU) provides automatic voltage control and contains fault sensing circuits which initiate a visible warning of voltage or frequency faults and, in addition, de-excite the generator for certain detrimental fault conditions.

The generator is cooled by oil from the exhaust of the hydraulic drive system, which is circulated to all heat-producing parts of the generator. Any over-temperature condition of the generator bearing or stator is sensed by resistance elements and indicated by an O/HEAT caption light controlled by associated relays. In addition, two caption lights, SELECTED and FAIL, indicate a 'selected' or 'fail' condition of the emergency generator. Signals operating the



Emergency AC Generation - Schematic
Figure 001

O/HEAT caption light are also passed to the master warning system (Ref. 33-15-00).

R **ON A/C 001-005,
R Before SB 24-023

A mode switch with the positions MANUAL, AUTO and GRD BY-PASS, and an isolate switch with the positions NORM and ISOL, provide manual control for the emergency generator. When the aircraft is on the ground, operation of the automatic control circuits is inhibited by landing gear controlled relays, but the GRD BY-PASS position of the mode switch provides an override condition to permit ground testing of the emergency generator.

R After SB 24-023 For A/C 001-005,

R A mode switch with the positions MANUAL, AUTO and GRD BY-PASS,
R and an isolate switch with the positions NORM and ISOL,
R provide manual control for the emergency generator. When
R the aircraft is on the ground, operation of the automatic
R control circuits is maintained by an override relay while
R No.1 and/or No.2 engine is/are running, but is inhibited
R by landing gear controlled relays while No.1 and No.2
R engines are stopped (speed below 58 per cent N2). The
R GRD BY-PASS position of the mode switch provides an over-
R ride condition for ground testing of the emergency
R generator.

A magnetic indicator shows the open or closed position of the ASB and a kVA meter provides indication of emergency loading.

The emergency generation captions, controls, indicator and kVA meter are located at the third crew member's station.

2. Emergency Generator

The three-phase emergency generator, located in the equipment bay, zone 153, is an oil-cooled brushless type with a continuous rating of 30 kVA. The generator comprises a six-pole rotor rotating in a three-phase stator, an a.c. exciter and rectifier assembly and a single-phase permanent magnet generator (PMG). The main rotor, a.c. exciter and PMG share a common shaft which rotates at a constant 8,000 rpm.

The PMG employs a permanent magnet secured to the shaft of the generator and a single-phase stator, the output of which

is approximately 40 V 800 Hz. The PMG provides power for the a.c. exciter field, in conjunction with the CPU, and also powers the CPU warning and protection control circuits.

Two platinum-resistance temperature-sensing elements, one near the stator casing, the other on a bearing housing cap, sense the temperature of the stator and non-drive end bearing.

A terminal enclosure fitted to the generator body, houses, in addition to the main electrical terminals to the output connections of the stator, radio interference suppression capacitors and a set of three current transformers. The current transformers form part of an associated differential protection circuit.

A hydraulic drive/generator mounting interface connects the generator to the drive unit and provides support for the drive end of the generator shaft. The non-drive end of the generator shaft is supported by a bearing lubricated with hydraulic fluid.

3. Control and Protection Unit (CPU) (Ref. Fig. 004)

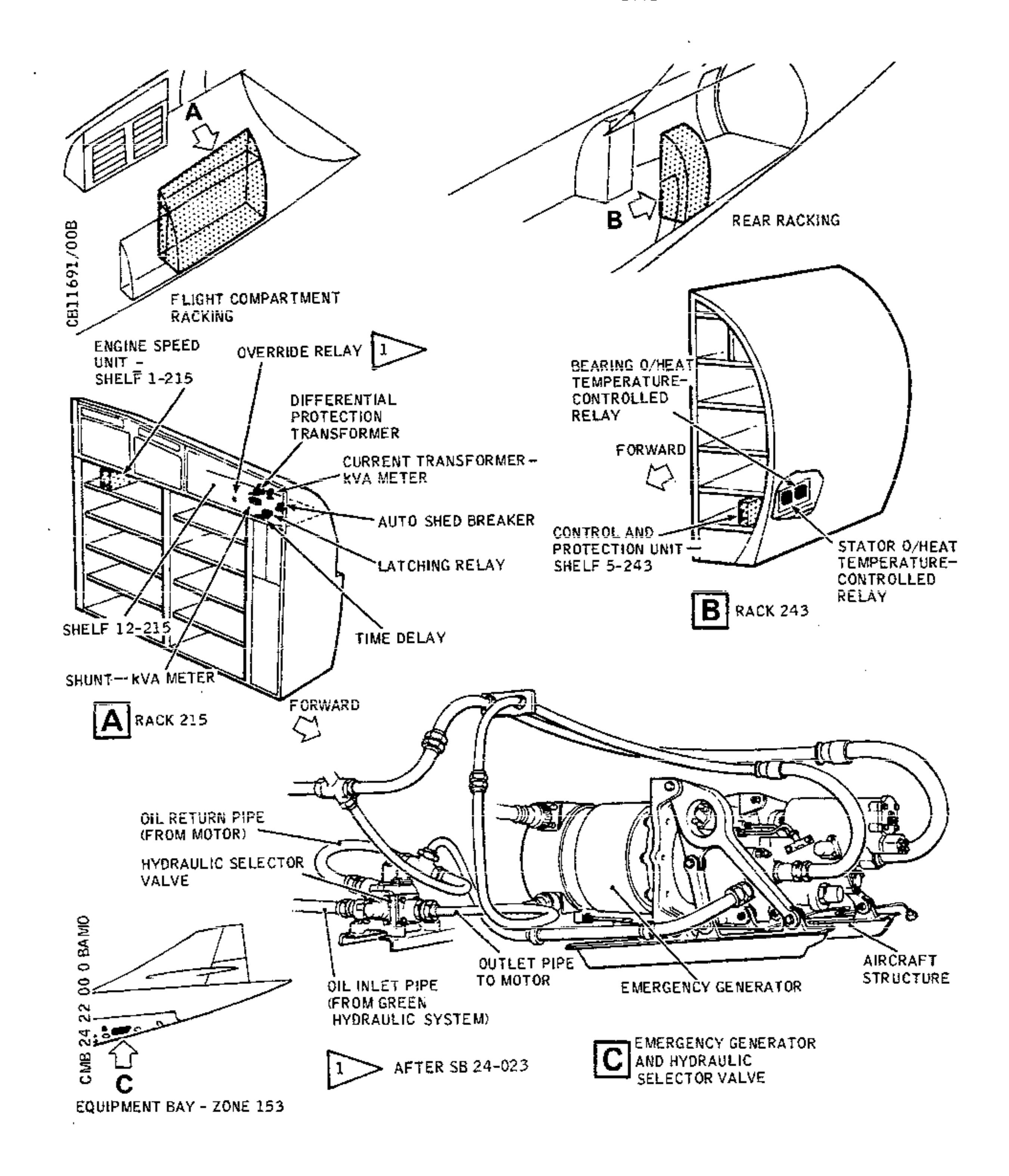
**ON A/C 001-005,

R **ON A/C 006-007,

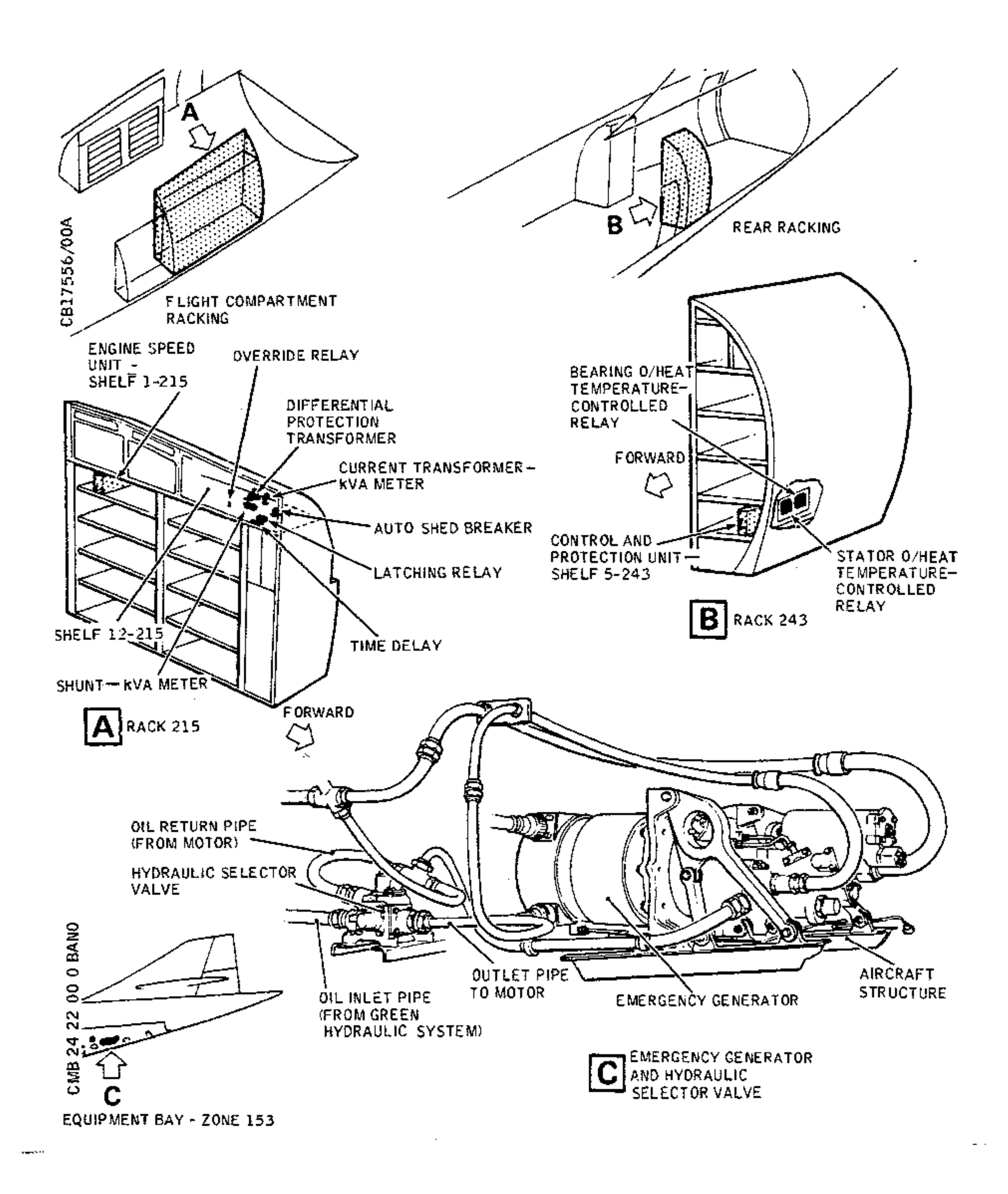
This unit is located in the rear racking on shelf 5-243 and provides voltage regulation, over-voltage protection and differential protection for the emergency generation system. In addition, the CPU initiates a visible warning if the generator output voltage or frequency deviates from the correct value by more than a pre-set amount.

The CPU comprises a voltage regulator, and protection and failure warning control circuits. Power for these circuits is derived from the PMG in the generator, but 28 V d.c. supplies from the aircraft busbars are fed to the CPU and are used to power an external 'fail' indication and a protection circuit reset (generator reset) facility.

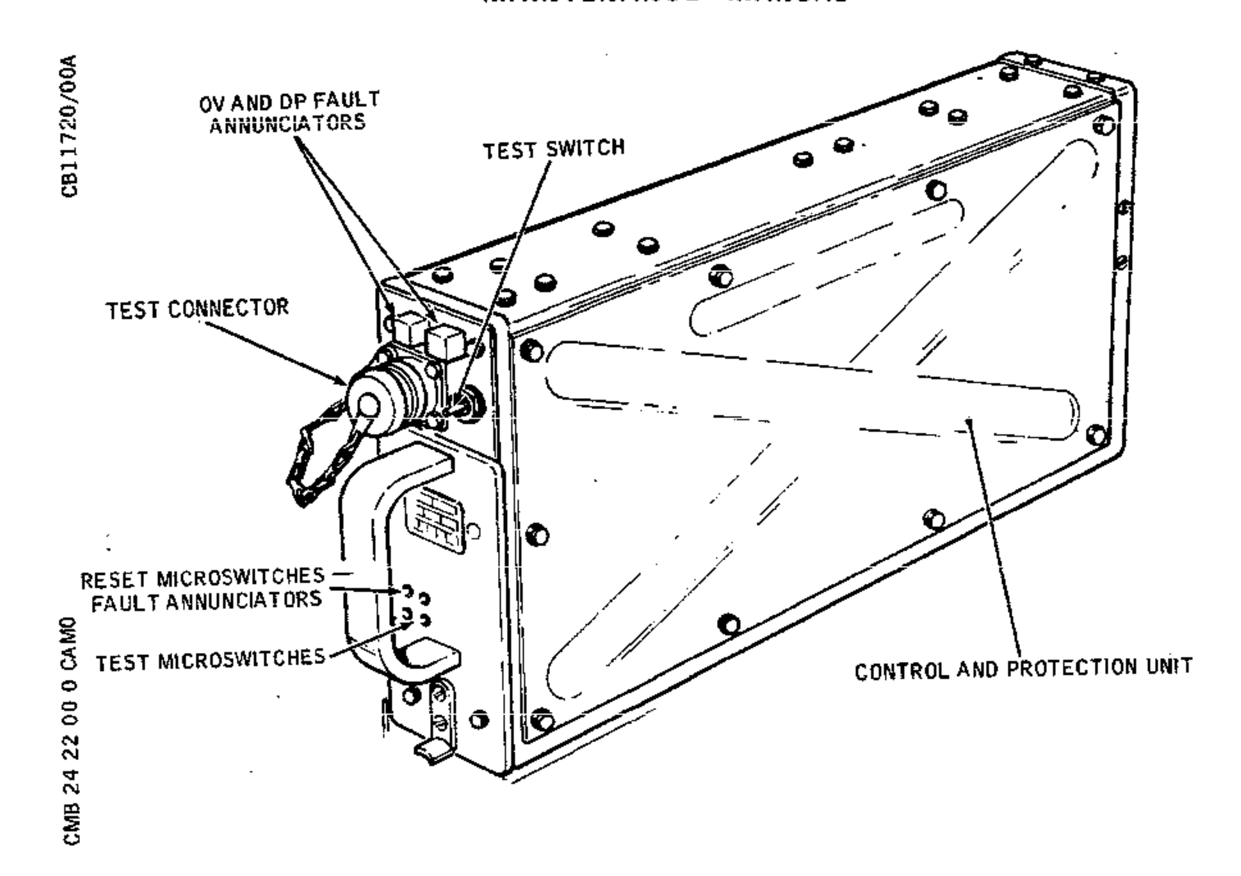
The voltage regulator maintains the generator output voltage at a constant level by sensing the output voltage and varying the generator field current as necessary. The protection circuits automatically de-excite the generator if over-voltage (OV) or a differential fault (DP) on the feeder cables between the generator and the ASB occurs. Failure warning control circuits initiate a 'fail' indication if the generator output voltage or frequency deviates from pre-set limits.



Equipment Location
R Figure 002



Equipment Location
Figure 003



Control and Protection Unit
Figure 004

To assist trouble shooting, indication of OV or DP faults is displayed on two electrically-operated mechanically-latched indicators (annunciators) mounted on the CPU front panel. Two sub-miniature microswitches, one for each annunciator, are fitted on the inside of the front panel and are used to reset the annunciators.

Each microswitch is operated by inserting a suitable probe through an associated hole in the CPU front panel, but the annunciators cannot be reset unless the generator is running and generating power, i.e., CPU power supply is available.

Two additional sub-miniature microswitches and a push-button switch enable the DP and OV protection circuits to be tested. The microswitches are operated in a similar manner to the 'reset' microswitches and, in conjunction with the push-button switch, are used to inject a 'trip' signal into the circuit to be tested. A test connector, close to the push-button, is provided to facilitate system testing and fault location.

4. Temperature-controlled Relays

Two of these relays (bearing and stator) are used in the system. Both relays are located in the rear racking on shelf 7-243 and operate in conjunction with the generator temperature sensing elements and an associated caption light to provide warning of any excessive temperature in the generator stator or non-drive end bearing.

The relays are identical and each comprises an encapsulated bridge network (the bridge being completed by the associated temperature sensing element), a transistor amplifier, voltage stabilizer and a relay. External electrical connections are made at a terminal block moulded into the encapsulation.

Bridge unbalance beyond a pre-set limit, caused by the bearing or stator element sensing excess temperature, initiates relay operation and subsequent warning indication.

5. Differential Protection Current Transformer

This unit is located in the flight compartment racking on shelf 12-215. It comprises a set of three toroidal current transformers with iron tape cores and tubular insulating inserts that accommodate the system feeder cables. The three transformers sense the current in each feeder cable of the three-phase supply close to the ASB and, in conjunction with the set of three current transformers fitted in the generator terminal enclosure, provide sensing voltages for the differential protection control circuit in the CPU, thus providing protection against feeder cable faults between the two sets of transformers.

6. Engine Speed Unit

The engine speed unit is also associated with engine starting (Ref. Chap.80), and engine power control (auto contingency) (Ref. Chap.76), and is located in the flight compartment racking on shelf 1-215. It monitors signals from four engine-mounted pulse probes, which sense the speed of each engine, and initiates emergency generation and/or automatic load shedding for certain engine failure conditions. Nos.1 and 2 engine pulse probes only are associated with emergency generator automatic starting and automatic load shed control.

The unit comprises signal amplifiers, logic circuits and relays, and is powered by a 28 V supply from the 'A' system essential d.c. busbar. The whole assembly is contained in a 1/4 ATR short case.

7. Auto Shed Breaker (ASB)

The ASB is an electromagnetic contactor located in the flight compartment racking on shelf 12-215 and interposed in the circuit between the emergency generator output and 'B' system emergency 115 V a.c. busbar. The ASB is controlled by the engine speed unit and effects automatic load shedding for certain engine failure conditions. One auxiliary contact of the ASB controls an associated magnetic indicator and a second auxiliary contact is associated with
R the flight compartment windshield heating (Ref. 30-41-00).

8. Latching Relay

This relay is located in the flight compartment racking on shelf 12-215 and provides an electrical hold-on facility for the hydraulic selector valve, after the automatic control circuits have initiated emergency generator operation.

The latching relay circuit incorporates a 150 ms time delay which ensures that the inhibit function of the landing gear controlled relays is fully established when electrical power is initially switched on while the aircraft is on the ground, thus preventing inadvertent operation of the emergency generator.

9. Hydraulic Selector Valve

The hydraulic selector valve is mounted in the equipment bay, zone 153, in the hydraulic pipeline between the emergency generator drive motor and the green hydraulic system.

The selector is electrically operated to direct the supply of hydraulic fluid to the emergency generator drive motor or, alternatively, to allow fluid from the drive motor to pass to the return line. The unit has no neutral position and the main flow is controlled by a slide valve actuated by fluid pressure, diverted as required by a solenoid-operated pilot valve.

R **ON A/C 001-005,

R After SB 24-023 For A/C 001-005,

R 10. Override Relay

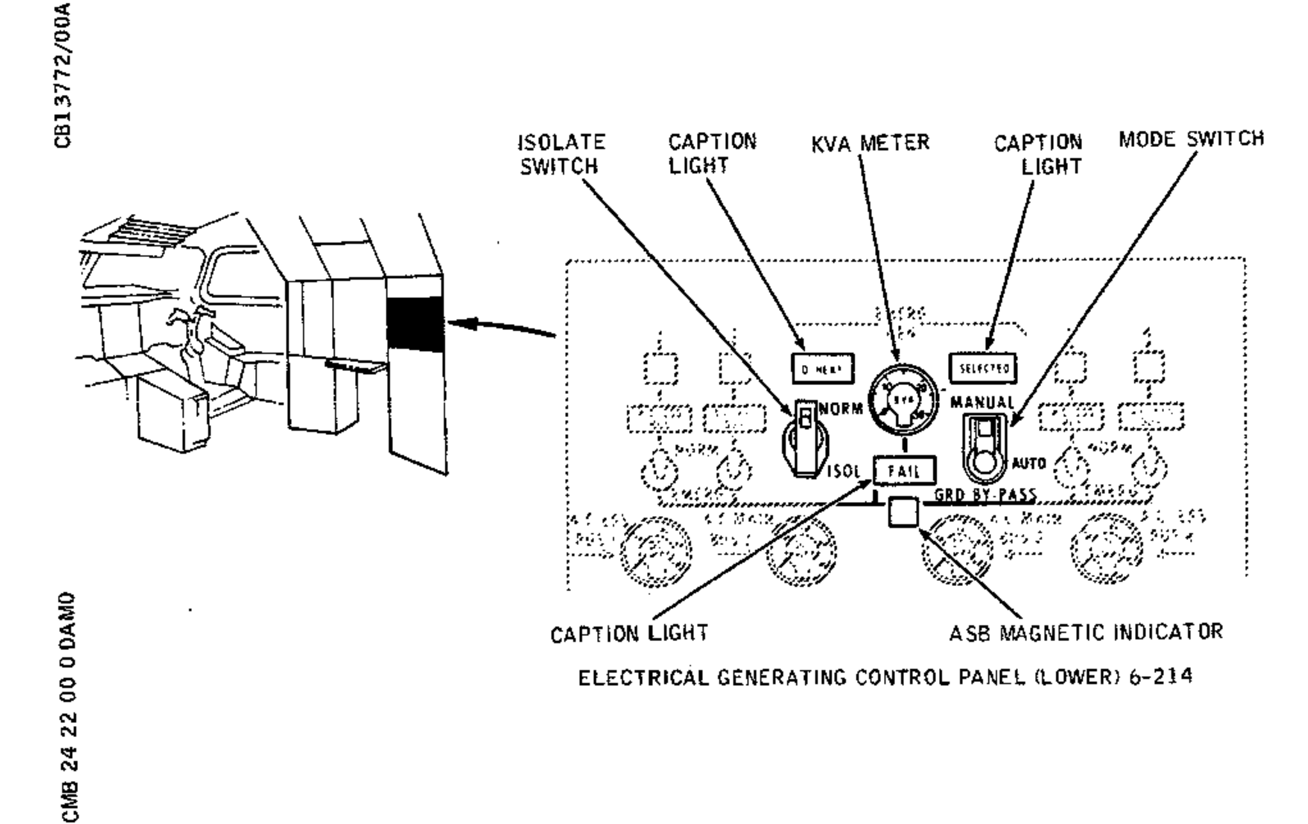
R The override relay is mounted on shelf 12-215 in the flight
R compartment racking. It operates in a landing gear controlled
R relays bypass circuit and is controlled by the engine speed

R unit.

R The bypass circuit ensures that when the aircraft is on the
R ground and No.1 and/or No.2 engine is/are running, the
R emergency generator is switched on automatically in the
R event of loss of voltage on any main a.c. busbar.

R 11. Operation

A. Control and Indication (Ref. Fig. 005)



Controls and Indicators
Figure 005

The emergency generator mode switch, isolate switch, O/HEAT, SELECTED and FAIL captions, together with the ASB magnetic indicator and the kVA meter, are mounted on the lower section of the electrical generating control panel (6-214).

The mode switch is of the guarded type having four poles, three of which are connected in the control circuits; the switch has three positions which are effective as follows:-

R **ON A/C 001-005,
R Before SB 24-023

(1) AUTO: The emergency generator switches on
R automatically, and is then latched on, upon
R failure of No.1 and No.2 engines, or failure
R of any main a.c. busbar. The operation
of the automatic control circuit is
inhibited by landing gear controlled
relays when the aircraft is on the ground.

(2) MANUAL: The emergency generator is switched on manually and the automatic control circuit and the landing gear controlled relays are overridden.

(3) GRD BY-PASS: The landing gear controlled relay circuit is bypassed when the aircraft is on the ground and the emergency generator switches on automatically when the conditions for automatic start exist.

R After SB 24-023 For A/C 001-005,

R (1) AUTO: The emergency generator switches on
R automatically, and is then latched on,
R upon failure of No.1 and No.2 engines,
R or failure of any main a.c. busbar.

R When the aircraft is on the ground, the
R effect of landing gear controlled relays
R and the override relay is as follows:-

R (a) While No.1 and No.2 engines are
R stopped (speed below 58 per cent N2),
R automatic starting of the emergency
R generator is inhibited.

R (b) While No.1 and/or No.2 engine is/are
R running, the emergency generator
R switches on automatically upon
R failure of any main a.c. busbar.

(2) MANUAL: The emergency generator is switched on manually and the automatic control circuit and the landing gear controlled relays are overridden.

(3) GRD BY-PASS: The landing gear controlled relay circuit is bypassed when the aircraft is on the ground and the emergency generator switches on automatically when the conditions for automatic start exist.

The isolate switch is a two-pole guarded type with two positions, NORM and ISOL, which are effective as follows:-

(1) NORM: Permits automatic or manual switching on of the emergency generator.

(2) ISOL: Isolates the automatic, latching and manual control circuits, thus preventing operation of the emergency generator.

The O/HEAT caption is illuminated in the event of an over-temperature condition of the generator bearing or stator, which also initiates a master warning (Ref. 33-15-00).

The SELECTED caption is illuminated when the emergency generator is switched on by automatic or manual control.

The FAIL caption is illuminated if the emergency generator output is outside prescribed limits.

The O/HEAT and FAIL caption light modules incorporate a press-to-test facility, and the action of the FAIL press-to-test also initiates a generator reset facility. The filaments in the O/HEAT SELECTED and FAIL captions can also be tested by a flight compartment filament test (Ref. 33-14-00).

The ASB magnetic indicator displays cross-line or in-line to denote the open or closed position, respectively, of the ASB.

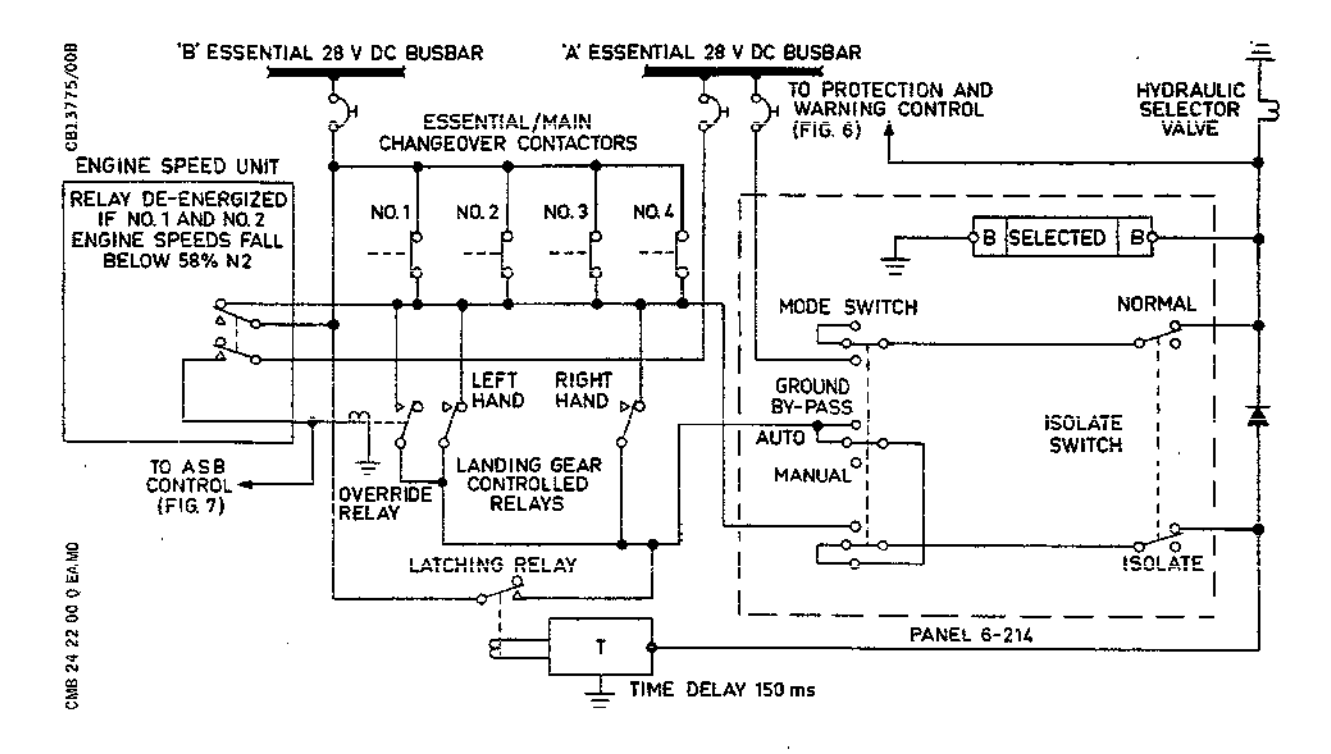
The kVA meter indicates the output of the emergency generator. The meter shunt and the associated current transformer, which senses the emergency generator phase 'A' current, are located in the flight compartment racking on shelf 12-215.

B. Functional Description

R **ON A/C 006-007,

(1) Emergency Generator Start Control (Ref. Fig. 006)

R **ON A/C 006-007,



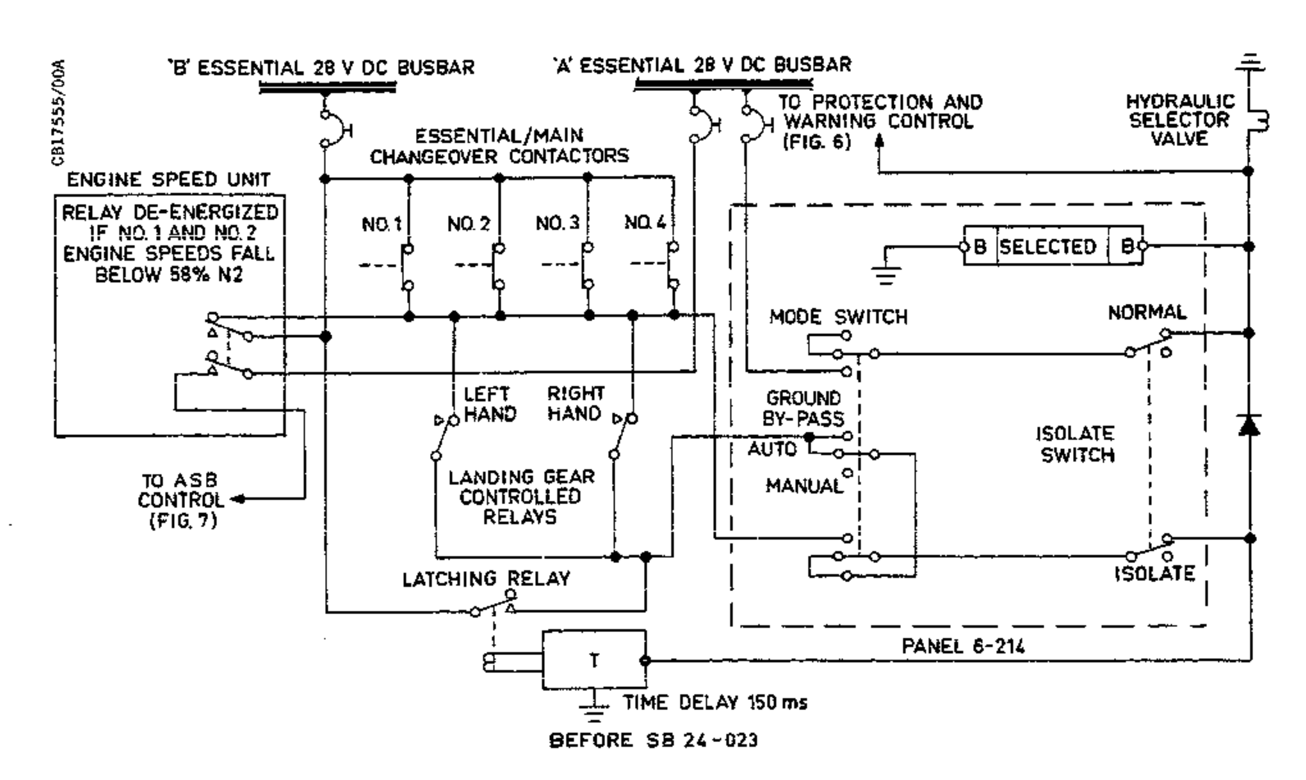
Emergency Generator Start Control
Figure 006

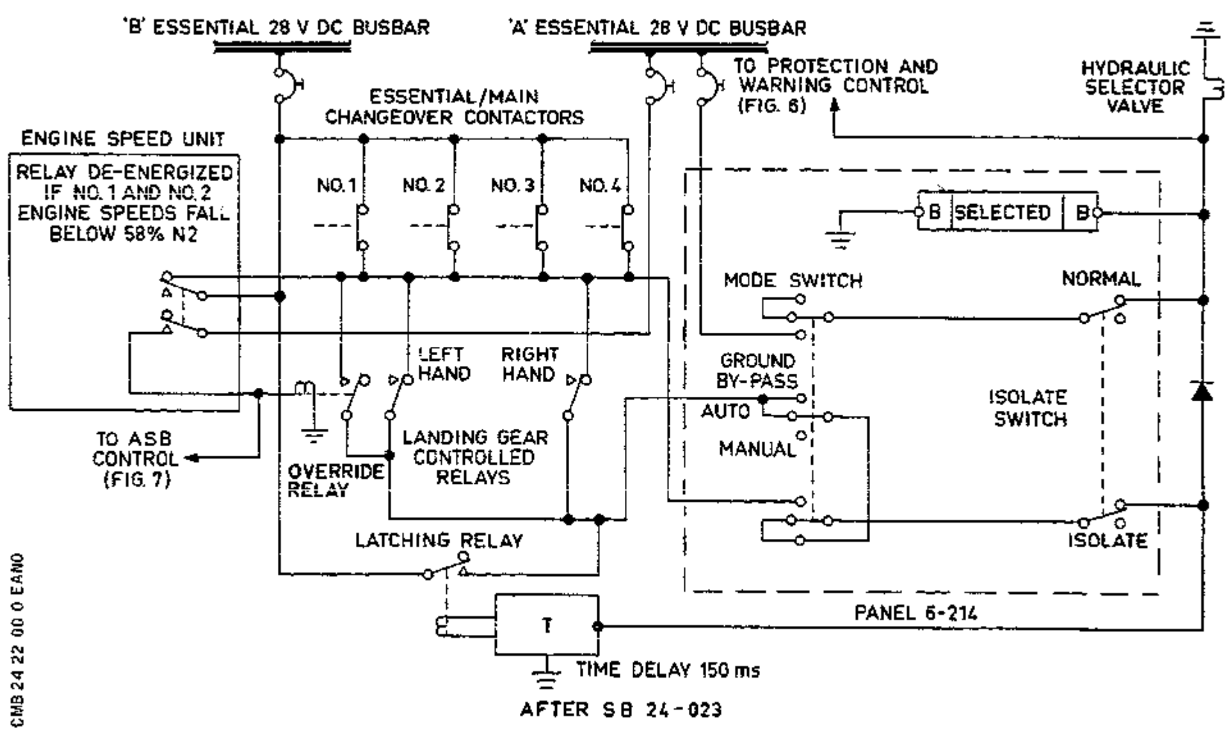
**ON A/C 001-005,
(1) Emergency Generator Start Control (Ref. Fig. 007)

Before SB 24-023

Normally the switch guards retain the mode switch at AUTO and the NORM - ISOL switches at NORM, thereby placing the emergency generator under control of the essential/main change-over contactors (Ref. 24-51-00) and the engine speed unit. The initial start circuit is routed to two landing gear controlled relays which inhibit the automatic start circuits when the aircraft is on the ground.

After SB 24-023 For A/C 001-005,





Emergency Generator Start Control
Figure 007

Normally the switch guards retain the mode switch at AUTO and the NORM - ISOL switches at NORM, thereby placing the emergency generator under control of the essential/main change-over contactors (Ref. 24-51-00) and the engine speed unit. The initial start circuit is routed to two landing gear controlled relays and the override relay, which affect the automatic start circuits when the aircraft is on the ground so that -

(a) while No.1 and/or No.2 engine(s) is/are stopped (speed below 58 per cent N2), the override relay is de-energized and the automatic start circuits are inhibited, and

(b) while No.1 and/or No.2 engine(s) is/are running, the override relay is energized, permitting automatic starting of the emergency generator under control of the essential/main change-over contactors.

The 150 ms delay in the latching relay coil circuit allows time for the landing gear controlled relays to be energized during initial switch-on of aircraft power, thereby ensuring inhibition of the initial start circuit to prevent inadvertent starting of the emergency generator.

When the aircraft is airborne the landing gear controlled relays are de-energized and the inhibit condition is completely removed. Normally, the essential/main contactors are energized but are de-energized if the voltage on the associated a.c. main busbar falls below a predetermined level. An auxiliary contact of any essential/main contactor that becomes de-energized will complete a circuit, via the landing gear controlled relays and the control switches, to the hydraulic selector valve which, in turn, initiates emergency generator operation by means of the hydraulic drive system (Ref. 24-12-00). Main contacts of the de-energized contactor(s) connect the output of the emergency generator to the associated essential busbar(s) (Ref. 24-51-00). The contactors can also be de-energized manually by associated control switches (NORM - EMERG) which override the automatic control and, in effect, start the emergency generator and connect its output to the respective essential a.c. busbar.

Automatic starting of the emergency generator is also initiated if No.1 and No.2 engine speeds fall below 58 per cent N2. In this condition an associated relay in the engine speed unit is de-energized and its contacts connect a 28 V d.c. supply to the hydraulic selector valve through the landing gear controlled relays and the control switches. In this configuration the emergency generator runs on 'no load' but is ready to come on line as required by subsequent automatic or manual switching, with a minimum of interrupt time.

In both automatic start operations a 28 V d.c. supply is also connected to the SELECTED caption light, the temperature controlled relays, a warning circuit in the CPU (generator 'fail') and to the coil of the latching relay. The latching relay is thus energized and its contacts complete a circuit that bypasses the automatic start circuits and landing gear controlled relays and provides an independent supply for the latching relay coil, the selector valve and the associated circuits. Changes in the configuration of the automatic start circuits or landing gear controlled relays now have no effect on the supply to the selector valve. When required, generator shut-down is accomplished by selecting ISOL at the NORM - ISOL switch.

Setting the mode switch to MANUAL starts the emergency generator by manual control independently from and overriding all other start controls. With the switch at MANUAL a 28 V d.c. supply is connected direct to the selector valve, the SELECTED caption light, the temperature-controlled relays and the warning circuit in the CPU, but a diode inhibits the supply to the latching relay coil.

The 28 V d.c. supplies for the automatic and manual start control circuits are obtained from separate busbars so that a fault in the automatic control circuits, including the supply busbar, will not affect manual starting of the emergency generator.

The GRD BY-PASS position of the mode switch permits the testing of the emergency generator automatic controls on the ground. With the switch at GRD BY-PASS, a circuit is connected that bypasses the landing gear controlled relays.

The automatic control circuits operate in a similar manner to that described for the AUTO position of the mode switch, except that the latching relay, although energized, has no effect.

(2) Protection and Warning Control (Ref. Fig. 008)

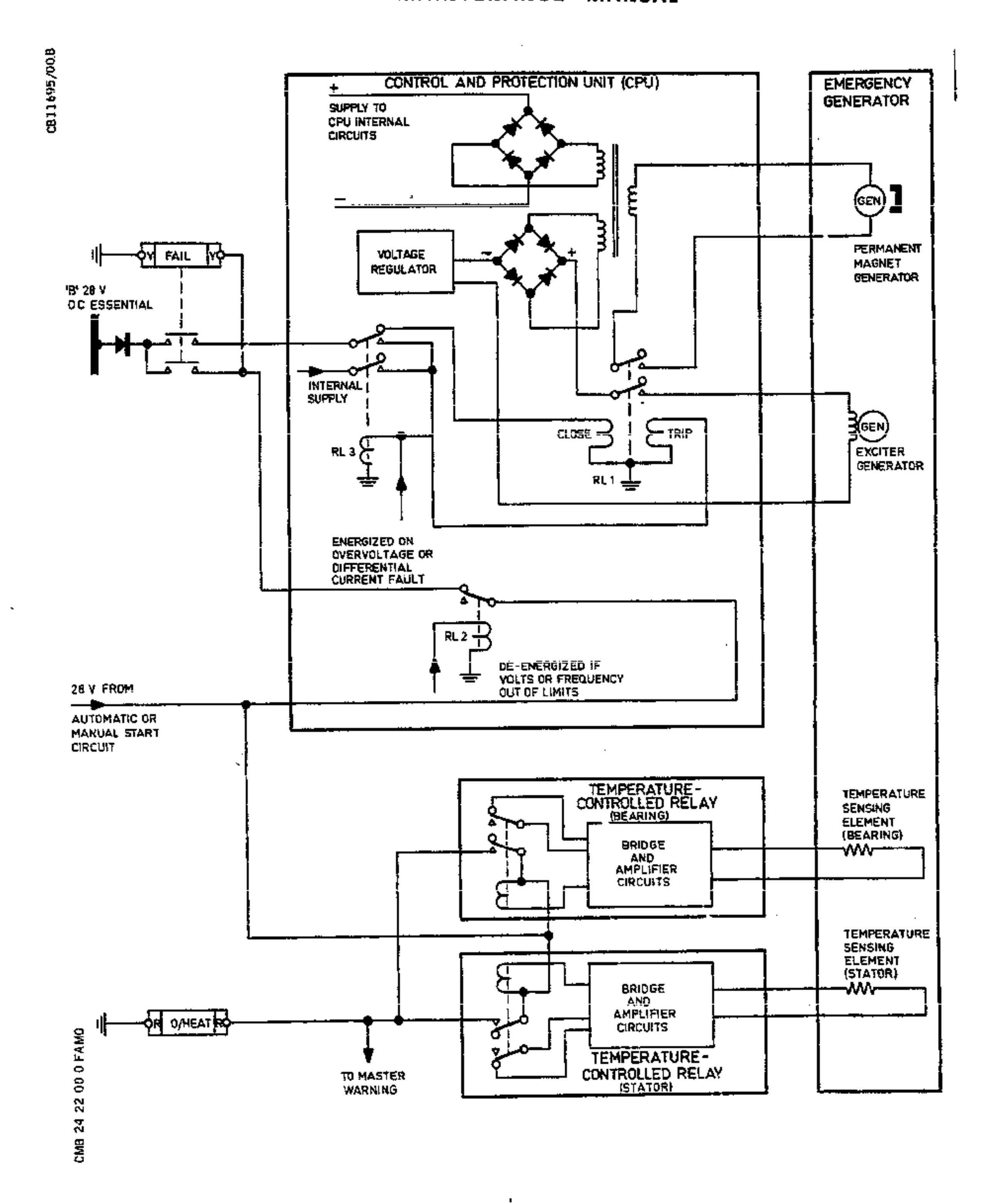
Protection and warning control for the emergency generator system is effective as follows:-

The permanent magnet generator (PMG) in the emergency generator provides power for a transformer in the CPU. Two secondaries of this transformer are connected to associated bridge rectifiers. One rectifier supplies d.c. power for the CPU internal circuits, and the other supplies d.c. power, via the CPU voltage regulator, for the field circuit of the emergency generator exciter. The supply from the PMG and the supply to the exciter field are both routed through contacts of CPU relay RL1. This relay is mechanically latched and has independent close and trip coils which are connected to contacts of CPU relay RL3. Normally, RL1 is in the mechanically-latched 'close' configuration.

RL3 is energized if emergency generation over-voltage or differential current faults occur. When RL3 is energized, its contacts connect a supply to the trip coil of RL1 which, in turn, open-circuits the PMG output and the exciter field supply, thereby inhibiting emergency generation. Normally, RL3 is de-energized and its contacts connect a reset circuit to the close coil of RL1. This reset function is activated through the press-to-test facility of the emergency generator FAIL caption light.

If RL3 energizes while reset is applied or if reset is applied while RL3 is energized, strapping connections between the normally-open contacts and the coil of RL3 connect the reset supply to the trip coil of RL1 and to the coil of RL3. Thus, reinstatement of the emergency generator cannot be initiated until a fresh reset selection is made.

CPU relay RL2 controls the 'fail' indication power supply to the FAIL caption light. Normally, this relay is energized whenever the emergency generator is running, but is de-energized if the



Protection and Warning Control
Figure 008

emergency generator output voltage or frequency deviates by more than a predetermined amount from the nominal values of 115 V and 400 Hz.

Although a differential current fault has no direct effect on RL2, if RL3 becomes energized RL2 will be automatically de-energized through subsequent under-voltage/under-frequency and loss of CPU internal power supply. Therefore, a FAIL indication will be displayed on the caption light.

Any excess of temperature in the emergency generator stator or bearing is sensed by the respective sensing element, which causes the bridge circuit in the associated temperature-controlled relay to become unbalanced. If the temperature exceeds a predetermined limit, a signal from the bridge network is amplified and applied to the base of a transistor which switches on and completes the earth circuit of the relay coil. Thus, the relay is energized and 28 V d.c. from the automatic start circuit is connected to display O/HEAT on the overheat caption light. Contacts of the energized relay also change the bridge network configuration by effectively introducing an additional resistance. This lowers the equivalent stator or bearing temperature at which the relay will de-energize, thus preventing transient overheat indications and relay cycling.

(3) Auto Shed Breaker Control (Ref. Fig. 009)

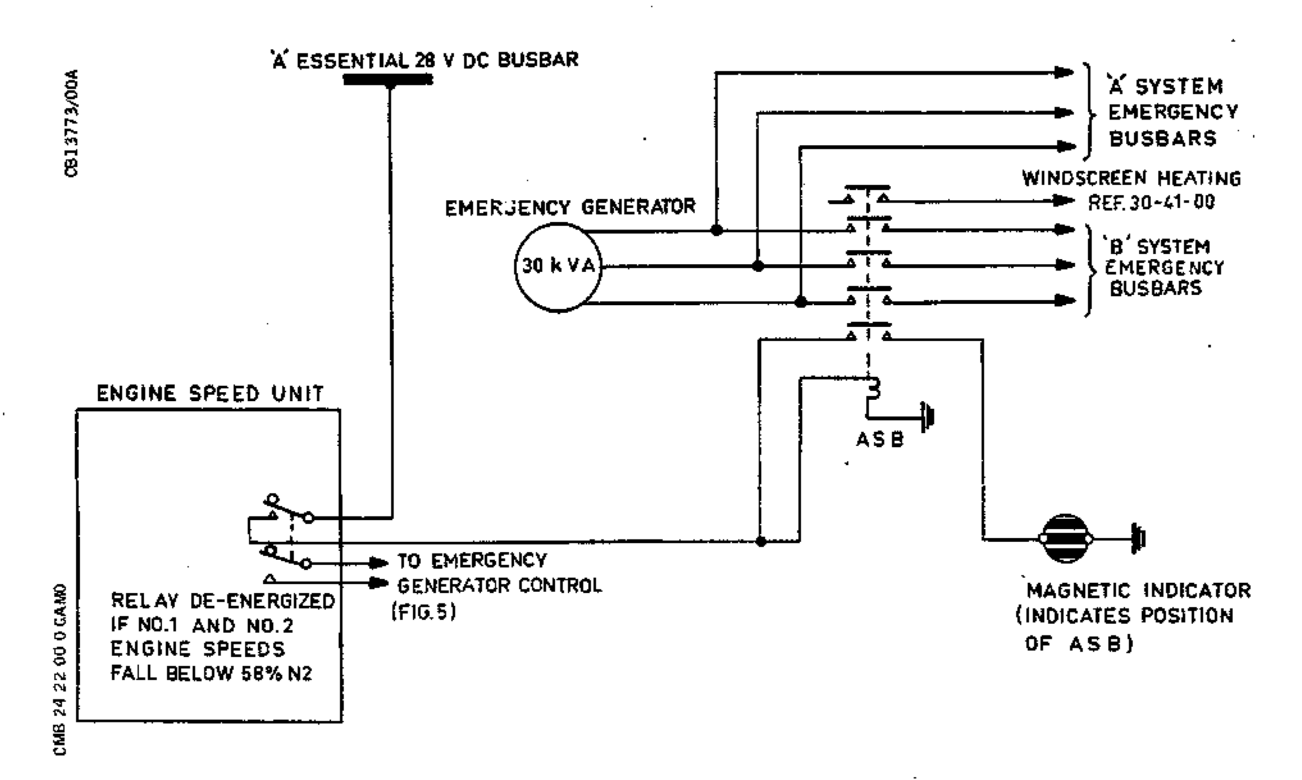
During flight, the ASB is energized by a 28 V d.c. supply through relay contacts in the engine speed unit, and the ASB main contacts connect the emergency generator to 'B' system emergency 115 V a.c. busbars.

If both No.1 and No.2 engine speeds fall below 58 per cent N2 the associated relay in the engine speed unit is de-energized. In consequence, the ASB is de-energized and opens the main and auxiliary contacts so that -

(a) the 'B' system emergency busbars are shed,

(b) the ASB magnetic indicator display changes to cross-line, and

(c) operation of high power heating of the left windshield is inhibited (Ref. 30 41-00).



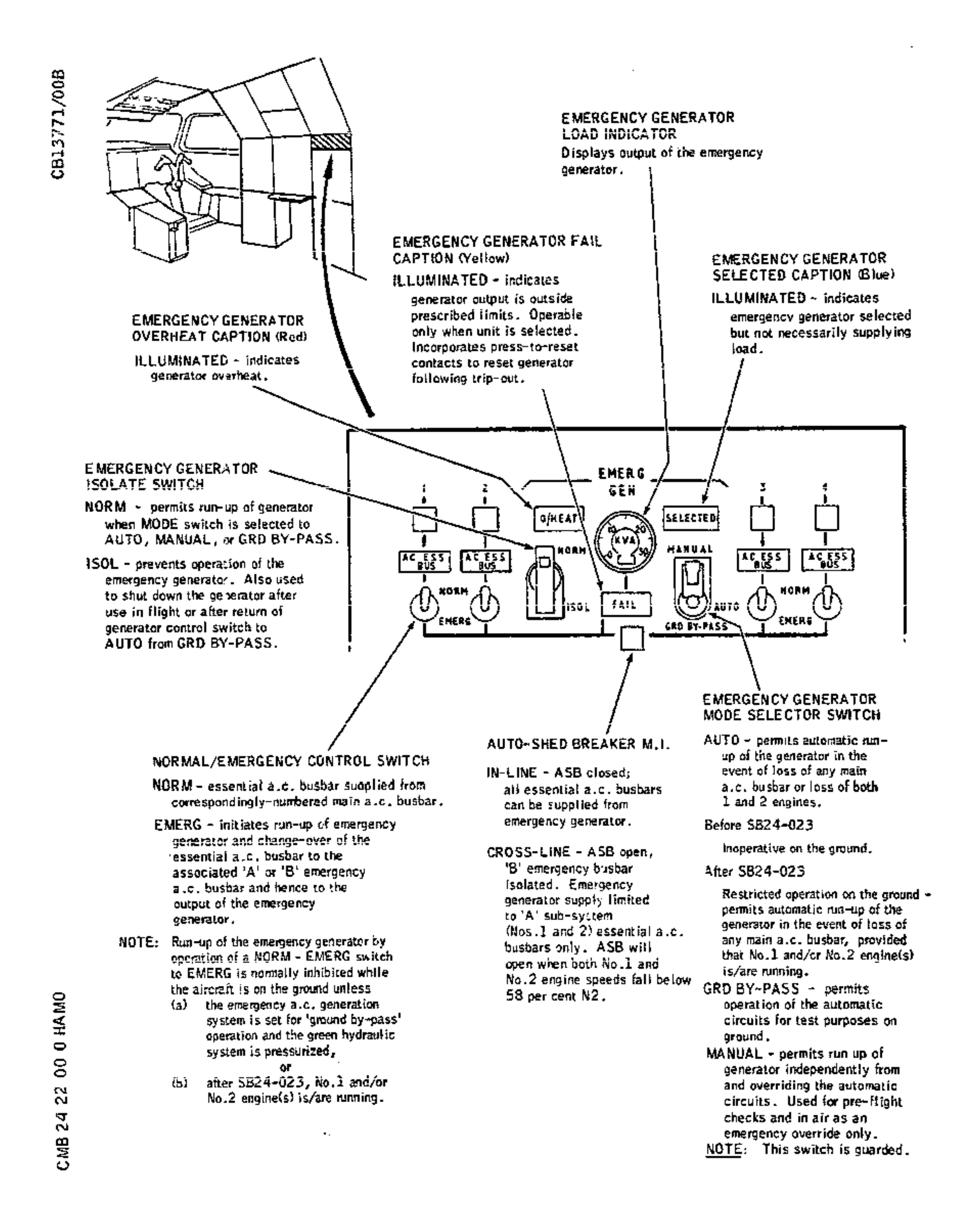
Auto Shed Breaker Control
Figure 009

(4) Hydraulic System Failure

In the event of a four-engine failure condition resulting in the main generators going off-line (Ref. 24-21-00) and insufficient hydraulic output from the green hydraulic system to maintain essential aircraft controls and the emergency generator, a hydraulic pump driven by an emergency power unit (ram air turbine) (Ref. Chap.29) is used to supplement the diminishing oil flow.

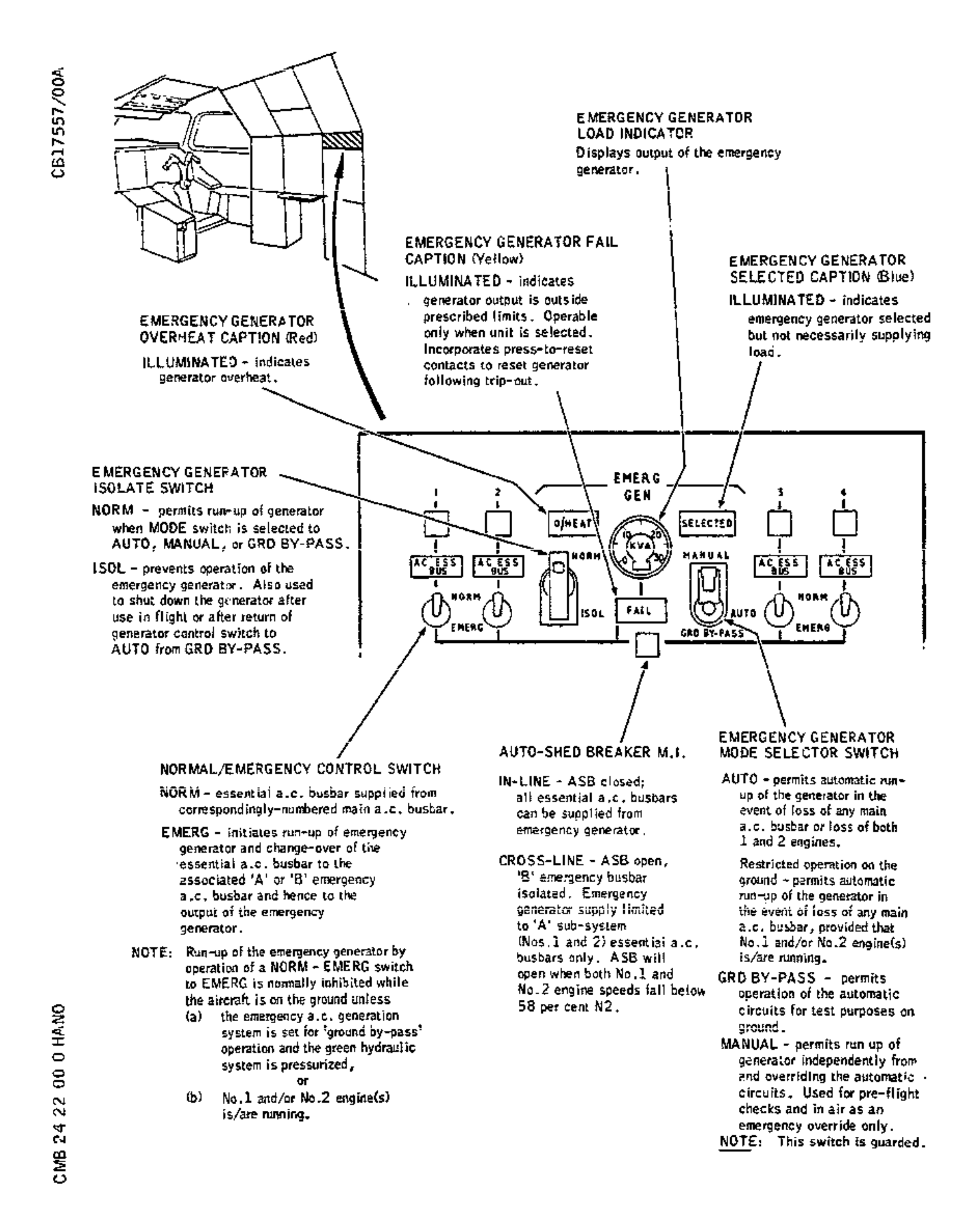
**ON A/C 001-005,
12. System Management (Ref. Fig. 010)

R **ON A/C 006-007,
12. System Management (Ref. Fig. 011)



Essential AC Controls and Indicators
Figure 010

R



Essential AC Controls and Indicators
Figure 011

Normally each essential 115 V a.c. busbar is supplied from its associated main a.c. busbar (Ref. 24-51-00), but it can be transferred to the output of an emergency generator, rated 30 kVA 200/115 V 400 Hz, driven at a constant speed from the green hydraulic system.

The generator mode switch is normally guarded in the AUTO position. The system is then set so that in the event of failure of No.1 and No.2 engines, the emergency generator will be automatically brought into operation in readiness to accept a transferred load. In the event of loss of voltage on any main busbar the associated essential busbar is automatically transferred to the emergency generator and, if not already running, the emergency generator is started. This transfer can be effected manually, irrespective of main a.c. busbar voltage, by setting the associated NORM - EMERG control switch to the EMERG position.

R **ON A/C 001-005,
R Before SB 24-023

Operation of the emergency generator as above is normally inhibited by the landing gear controlled relays while the aircraft is on the ground, but the GRD BY-PASS position of the generator mode switch permits ground testing of the system and the MANUAL position of the switch provides overriding control for bringing the generator into operation in readiness to accept a transferred load. After return of the switch to AUTO from GRD BY-PASS, operation of the generator isolate switch to ISOL is necessary to effect shut-down of the generator.

R After SB 24-023 For A/C 001-005,

R Operation of the emergency generator as above is normally
R inhibited by the landing gear controlled relays while the
R aircraft is on the ground, and Nos.1 and 2 engines are stopped
R (speed below 58 per cent N2). This inhibition is removed how-
R ever while No.1 and/or No.2 engine(s) is/are running,
R permitting automatic run-up of the generator in the event of
R loss of any main a.c. busbar. When the inhibition on automatic
R start operation is effective, the GRD BY-PASS position of the
R mode switch permits ground testing of the emergency generator.
R After return of the mode switch to AUTO from GRD BY-PASS,
R operation of the generator isolate switch from ISOL is
R necessary to effect shut-down of the generator.

R R R The MANUAL position of the mode switch provides overriding control for bringing the generator into operation in readiness to accept a transferred load.

It is important to note that with the green hydraulic system pressurized, the generator mode switch at GRD BY-PASS and both Nos.1 and 2 engines stopped (speed below 58 per cent N2) the emergency generator will automatically be brought into operation. The auto shed breaker (ASB) will be open with both No.1 and 2 engine speeds below 58 per cent N2.

EMERGENCY AC GENERATION - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains instructions for the removal and installation of minor electrical components, associated with the emergency a.c. generation system, comprising two temperature-controlled relays (bearing and stator), and an emergency relight busbar selector switch. Instructions for the removal and installation of other minor electrical components, associated with the emergency a.c. generation system, which are mounted on the lower electrical generating control panel and in the flight compartment LH racking, are contained in 24-00-00.

Both temperature-controlled relays are mounted in the rear vestibule LH electronic racking (zone 243) on the outboard sidewall, and secured to a mounting plate by screws. Electrical connections to the relays are made to screw-type terminals.

The emergency relight busbar selector is a rotary switch located at the 3CM station on the engine starting panel (18-214). The switch is mounted from the rear of the panel, access being gained by removing the panel assembly from the 3CM station structure. Electrical connections to the switch are made by flying leads, the ends of which are connected to an electrical connector secured to a plug mounting plate at the rear of the panel.

2. Temperature-controlled Relay (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Trip the EMER GEN MANL CONT circuit breaker X211, on panel 1-213, map ref.R9, and the EMER GEN AUTO CONT circuit breaker X212, on panel 3-213, map ref.G10, and fit safety clips.

(2) Remove the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00).

(3) Gain access to the temperature-controlled relay by removing from shelf 5-243, Nos.1 and 4 air intake control units (Ref. 71-61-21), and the emergency generator control and protection unit (Ref. 24-22-21).

C. Remove

(1) Disconnect the electrical cables from the relay terminals.

(2) Remove the screws securing the relay to the mounting plate and withdraw the relay from the racking.

D. Install

(1) Comply with the electrical safety precautions.

(2) Fit the temperature-controlled relay on the mounting plate, with the terminal side of the relay facing down, and secure it with the screws.

(3) Connect the electrical cables to the relay terminals, ensuring that the connections are made in accordacnce with the cable identifications and the applicable wiring diagram.

E. Conclusion

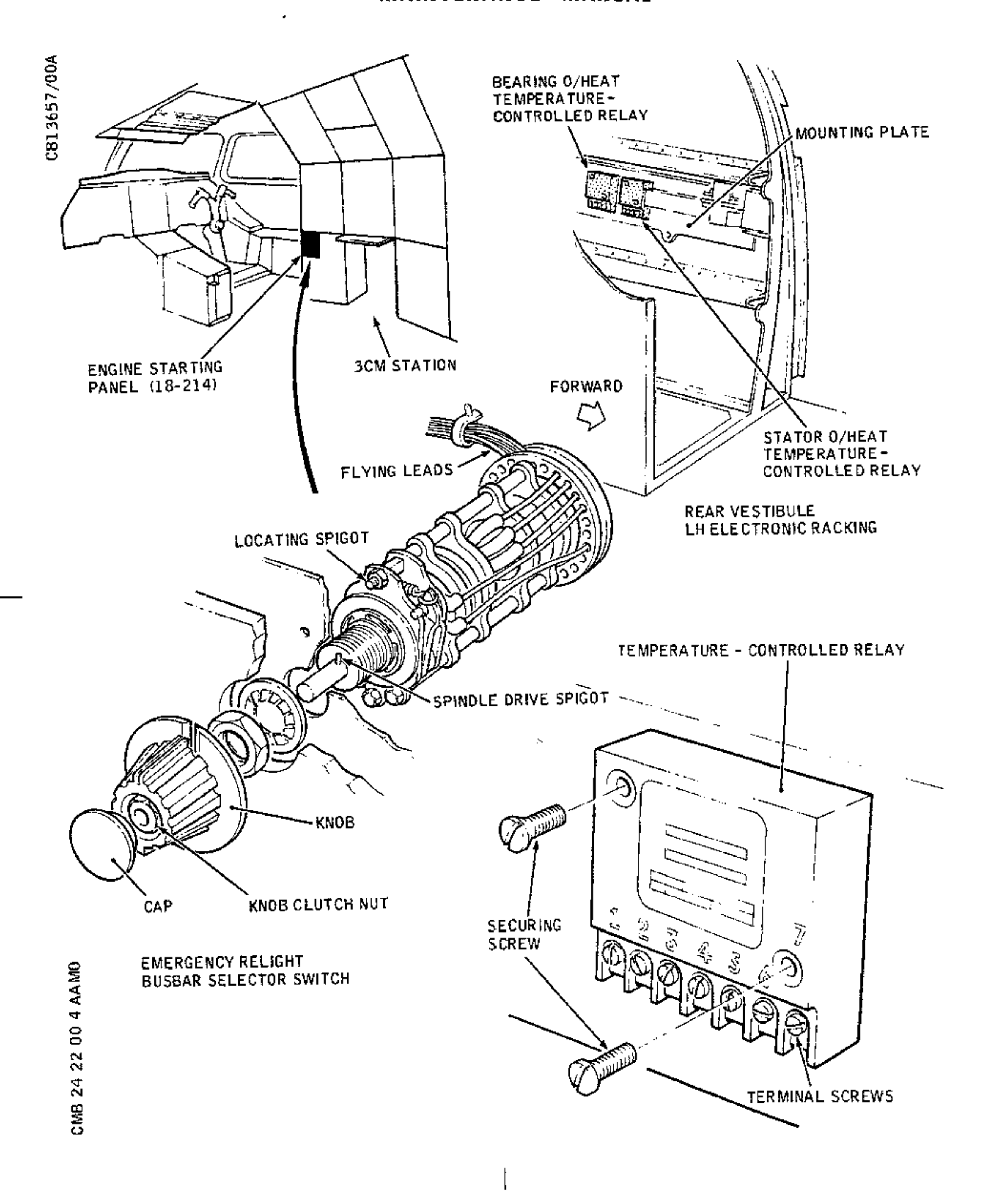
(1) Install the air intake control units Nos.1 and 4 (Ref. 71-61-21), and the emergency generator control and protection unit (Ref. 24-22-21).

(2) Cancel the electrical safety precautions taken before removal, and check the operation of the temperature-controlled relay by carrying out the appropriate test procedure.

(3) Install the rear vestibule LH electronic racking forward and decor bulkheads (Ref. 25-71-00).

3. Emergency Relight Busbar Selector Switch (Ref. Fig. 401)

CAUTION: ELECTROLUMINESCENT (EL) PANELS ARE VULNERABLE TO DAMAGE BY SCRATCHING AND CRACKING. ENSURE THAT TOOLS USED IN THE FOLLOWING OPERATIONS DO NOT DAMAGE THE POLISHED



- Minor Electrical Components - Installation
Figure 401

WALL OR EDGES OF THE EL PANEL.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Trip the circuit breakers listed below and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
No.2 & 3 EMER REL'T BUS SELECT SUP	1-213	1X230	R10
No.1 & 4 EMER REL'T BUS SELECT SUP	3-213	4X230	H8
LH W/SCREEN HTR CONT	1-213	1H142	J9
3CM STN PNL LTS SUP	14-216	L86	D9
ENG 1 RH IGNITION CONT	1-213	1J2	N6
ENG 2 RH IGNITION CONT	1-213	2J2	P6
ENG 3 RH IGNITION CONT	1-213	3J2	Q6
ENG 4 RH IGNITION CONT	1-213	4J2	R6
ENG 1 LH IGNITION CONT	3-213	1J1	E1
ENG 2 LH IGNITION CONT	3-213	2J1	E2
ENG 3 LH IGNITION CONT	3-213	3J1	E3
ENG 4 LH IGNITION CONT	3-213	4J1	E4
ENG 1 & 4 AIR START CONT	15-215	K181	C15
ENG 2 AIR START VALVE POSN IND	15-215	2K183	C16
ENG 3 AIR START VALVE POSN IND	15-215	3K183	C17
ENG 2 & 3 AIR START CONT	15-216	K182	D11

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG 1 AIR START VALVE POSN IND	15-216	1K183	D9
ENG 4 AIR START VALVE POSN IND	15-216	4K183	D10

(2) Release the quick-release fasteners securing the starting panel to the 3CM station structure, and withdraw the panel from its mounting to the extent of the electrical cables.

(3) Disconnect the electrical connectors from the rear of the panel and remove the panel clear of its mounting.

C. Remove

(1) At the back of the panel, remove the screws securing the dust cover surround to the panel assembly and withdraw the cover clear of the panel.

(2) Release the switch flying leads from the looms.

(3) Remove the nut securing the electrical connector, U2241, to the plug mounting plate and remove the connector from the plate.

(4) Disconnect the flying leads from the electrical connector in accordance with the Wiring Diagram Manual, 20-42-34. Label the leads to assist identification when reconnecting.

(5) Remove the cap from the end of the switch knob, loosen the clutch nut and withdraw the knob from the switch spindle.

(6) Using a tubular spanner, remove the nut and washer from the front of the panel and withdraw the switch from the rear.

D. Install

(1) Comply with the electrical safety precautions.

(2) Insert the switch through the aperture from the rear of the panel, ensuring that the spigot engages the locating hole in the panel.

(3) Secure the switch at the front of the panel with the nut and washer.

(4) Fit the knob on the switch spindle, ensuring that the spindle spigot is engaged with the slot in the knob. Tighten the clutch nut and refit the end cap.

(5) Connect the switch flying leads to the electrical connector in accordance with the Wiring Diagram Manual, 20-42-34, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(6) Fit the connector to the plug mounting plate and secure it with the nut.

(7) Secure the flying leads with suitable loom ties in accordance with 20-27-15.

E. Conclusion

(1) Fit the dust cover surround over the panel assembly from the rear, and secure it to the assembly with the screws.

(2) Connect the electrical connectors to the panel, ensuring that the mating surfaces are clean and undamaged.

(3) Refit the panel to its mounting and secure it with the quick-release fasteners.

(4) Cancel the electrical safety precautions taken before removal, and check the operation of the switches, magnetic indicators, caption light modules and panel illumination on panel 18-214 by carrying out the appropriate test procedures.

EMERGENCY AC GENERATION - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00, SERVICING.

OBSERVE THE HYDRAULIC FLUID PRECAUTIONS DETAILED IN 29-00-00.

1. General

This topic contains the Emergency AC Generation System Test, which is a comprehensive test carried out at major maintenance periods of the aircraft. It is divided, for convenience of application, into a series of tests identified under separate sub-headings as follows:-

Preliminary (Control and Indication)

Emergency Generator Overheat Indication

Differential Protection Current Transformers

Emergency Generator Operation and Power Distribution

Final - Main Engines Running

It is recommended that this series of tests be carried out as a complete sequence. At the conclusion of individual tests certain operations, e.g., switching off electrical ground power, may be omitted provided that a sequential test validates the omission.

Operational and Functional Tests are not included, because the checks of the Emergency AC Generation System that are required under each of these headings are incorporated in the Operational Test and the Functional Test given under the General section (Ref. 24-00-00, Adjustment/Test).

2. System Test

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

DESCRIPTION	PART NO.
Precision-grade a.c. voltmeter, range 110 to 125 V a.c., required for 'Final - Main Engines Running' test	-
Precision-grade frequency meter, range 350 to 450 Hz, required for 'Final - Main Engines Running' test	-
Precision-grade d.c. voltmeter, range 0 to 30 V d.c., required for 'Preliminary' test	-
Decade resistance box (two), range 100 to 200 ohm, required for 'Emergency Generator Overheat Indication' test	-
Throttle control system test set, required for 'Preliminary (Control and Indication)' test	QT6A16-24
Differential protection current transformers test supply, required for the 'Differential Protection Current Transformers' test, to check the impedance of each winding of the transformer under test. The requirement is for a 6 V 400 Hz single-phase supply limited so that under a fault condition (short-circuit) the current drawn will be approximately 500 mA	-
Precision-grade testmeter, range 0 to 1A at 400 Hz, required for 'Differential Protection Current Transformers' test	-

B. Preliminary (Control and Indication)

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN AND THE GREEN HYDRAULIC SYSTEM MUST NOT BE

PRESSURIZED DURING THIS PRELIMINARY TEST.

CAUTION: SUBSEQUENT TEST PROCEDURES REQUIRE THE TRIPPING OF CIRCUIT BREAKERS, TO ESTABLISH LEFT-HAND AND RIGHT-HAND WEIGHT SWITCH OPERATED RELAYS IN THE 'IN-FLIGHT' POSITION. CARE MUST BE TAKEN TO ENSURE THAT ALL SERVICES ADVERSELY AFFECTED BY THIS CONDITION ARE PREVIOUSLY ISOLATED (REF. 7-11-00).

NOTE: The following test procedures include operation of the engine speed unit (ESU) internal relay in the emergency generator automatic start and auto shed breaker (ASB) control circuits. The required input of engine speed signals to the ESU is provided by the throttle control system test set connected and operated as detailed below.

(1) Prepare

(a) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9, and fit safety clips.

(b) Trip the No.2 & 3 EMER REL'T SELECT SUP circuit breaker 1X230 on panel 1-213, map ref.R10, and fit a safety clip.

(c) Trip the EMERG POWER indication circuit breaker X210 on panel 23-215.

(d) Gain access to the emergency generator by opening access door 153 DB (Ref. 52-41-41) and disconnect the electrical connector (X206-A) from the emergency generator hydraulic selector valve mounted at the side of the generator.

(e) Connect the precision-grade d.c. voltmeter between inserts A (+ve) and C (-ve) of the hydraulic selector valve 'free' connector (X206A).

(f) Ensure that the EMERG RELIGHT BUSBAR selector switch on the engine starting panel, 18-214, is at OFF.

(g) Make available electrical ground power as detailed in 24-41-00.

(h) Trip the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Fit safety clips to the tripped circuit breakers.

(i) Gain access to the engine control amplifiers (throttle amplifiers) mounted on shelves 6-215 and 8-215 by removing the appropriate panels from the flight compartment left-hand racking.

(j) Locate No.1 engine main control amplifier (1K20) mounted on shelf 8-215, and No.2 engine main control amplifier (2K20) mounted on shelf 6-215.

(k) On the pilots' roof panel, 4-211, ensure that -

k1) No.1 engine and No.2 engine AUTO-IGNITION control switches are set to OFF,

k2) No.1 engine and No.2 engine HP VALVE control switches are set to SHUT, and

k3) No.1 engine and No.2 engine THROTTLE MASTER switches are set to OFF.

(l) Place a warning placard in the flight compartment, forbidding alteration of the switch settings specified in paragraphs k1), k2) and k3).

NOTE: The setting of Nos.1 and 2 engine throttle levers is not significant.

(2) Test

(a) Connect the throttle control system test set cable 2 between connector socket PL 2 on the test set and connector socket SKT 2 on the front of No.1 engine main control amplifier (1K20).

NOTE: The following test procedures do not require the setting of any control on the test set to a particular position; any setting will provide a satisfactory test condition.

(b) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel

3-213, map ref.G10. Check that Nos. 1, 2, 3 and 4 essential/main isolate magnetic indicators display in-line.

(c) Press the emergency generator FAIL and O/HEAT captions in turn and check that each one is illuminated when pressed and extinguished when released.

NOTE: The control and protection unit (CPU) reset facility is also energized when the FAIL caption is pressed.

(d) Set the emergency generator mode switch to "GRD BY-PASS" and check that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V. Check also that the emergency generator SELECTED and FAIL captions are not illuminated.

(e) Remove the safety clip and reset the EMERG POWER indication circuit breaker X210 on panel 23-215; check that the emergency generator SELECTED and FAIL captions are illuminated.

(f) Observe No.1 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, checking that the pointer on No.1 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(g) With the reading on No.1 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that -

g1) the emergency generator SELECTED and FAIL captions are extinguished,

g2) the ASB position magnetic indicator displays cross-line, and

g3) the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

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(h) Reset the No.2 & 3 EMER REL'T BUS SELECT SUP circuit breaker 1X230 on panel 1-213, map ref.R10, and check that the ASB position magnetic indicator changes from cross-line to in-line.

(i) Trip the ENG 1 MAIN THROT SUP circuit breaker lK1 on panel 2-213, map ref.F12, and check that when the reading on No.1 engine HP RPM (N2) indicator falls below approximately 58 per cent N2 -

i1) the emergency generator SELECTED and FAIL captions are illuminated,

i2) the ASB position magnetic indicator changes from in-line to cross-line, and

i3) the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(j) Fit a safety clip to the circuit breaker tripped in operation (i).

(k) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.1 engine main control amplifier and reconnect it to connector socket SKT 2 on the front of No.2 engine main control amplifier (2K20).

(l) Observe No.2 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Remove the safety clip and reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(m) With the reading on No.2 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that -

m1) the emergency generator SELECTED and FAIL captions are extinguished,

m2) the ASB position magnetic indicator changes from cross-line to in-line,

and

m3) the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(n) Set No.1 essential/main (NORM/EMERG) control switch to "EMERG" and check that the correspondingly numbered essential/main isolate magnetic indicator changes from in-line to cross-line and that the correspondingly numbered AC ESS BUS caption is illuminated.

(o) Check also that the emergency generator SELECTED and FAIL captions are illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(p) Return No.1 essential/main (NORM/EMERG) control switch to "NORM" and check that the correspondingly numbered essential/main isolate magnetic indicator returns to in-line, and that the correspondingly numbered AC ESS BUS caption is extinguished. Check also that the emergency generator SELECTED and FAIL captions are extinguished and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(q) Repeat operations (n), (o) and (p) as applied to Nos.2, 3 and 4 essential/main (NORM/EMERG) control switches.

(r) Set No.1 bus-tie breaker (BTB) control switch to "TRIP" and check that -

r1) the correspondingly numbered BTB position magnetic indicator changes from in-line to cross-line,

r2) the correspondingly numbered essential/main isolate magnetic indicator changes from in-line to cross-line,

r3) the corresponding numbered AC main bus and AC ESS BUS captions are illuminated,

r4) the emergency generator SELECTED and FAIL captions are illuminated, and

r5) the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(s) Return No.1 BTB control switch to "NORM" and check that -

s1) the correspondingly numbered BTB position magnetic indicator changes from cross-line to in-line,

s2) the correspondingly numbered essential/ main isolate magnetic indicator changes from cross-line to in-line,

s3) the correspondingly numbered AC MAIN BUS and AC ESS BUS captions are extinguished,

s4) the emergency generator SELECTED and FAIL captions are extinguished, and

s5) the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(t) Repeat operations (r) and (s) as applied to Nos.2, 3 and 4 BTB control switches.

(u) Trip the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, and check that when the reading on No.2 engine HP RPM (N2) indicator falls below approximately 58 per cent N2 -

u1) the emergency generator SELECTED and FAIL captions are illuminated,

u2) the ASB position magnetic indicator changes from in-line to cross-line, and

u3) the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve, is not less than 25 V.

(v) Set the emergency generator isolate switch to

"ISOL" and check that the SELECTED and FAIL captions are extinguished and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(w) Return the emergency generator isolate switch to "NORM" and check that the SELECTED and FAIL captions are illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(x) Set the emergency generator mode switch to "MANUAL" and check that the SELECTED and FAIL captions are extinguished and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(y) Remove the safety clip and reset the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9. Check that the SELECTED and FAIL captions are illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(z) Set the emergency generator mode switch to "AUTO" and check that the SELECTED and FAIL captions are extinguished and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

**ON A/C 001-005,

Before SB 24-023

(aa) Fit a safety clip to the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12.

(ab) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(ac) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.2 engine main control amplifier

and from connector socket PL 2 on the test set. Remove the test set, fit the captive protection caps to connector sockets SKT 2 on Nos.1 and 2 engine main control amplifiers and refit the panels removed to gain access to shelves 6-215 and 8-215.

(ad) Remove the safety clips and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Remove the warning placard placed in operation (1)(l).

(ae) Establish the left-hand weight switch operated relays in the 'in-flight' position by tripping the LH UC WEIGHT SW & DOWNLOCK 'B" SYS SUP circuit breaker G293 on panel 3-213, map ref.B8; ensure that all services adversely affected by this condition are isolated (Ref. 7-11-00). Fit a safety clip to the tripped circuit breaker.

(af) Check that the emergency generator mode switch is at AUTO.

(ag) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the emergency generator SELECTED and FAIL captions are illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(ah) Establish the left-hand weight switch operated relays in the 'ground' condition by removing the safety clip and resetting the circuit breaker tripped in operation (ae). Check that the emergency generator SELECTED and FAIL captions remain illuminated and that the voltage indicated on the voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(ai) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and that the voltage indicated on the voltmeter connected at the 'free'

connector of the hydraulic selector valve falls to zero.

(aj) Trip the EMER GEN AUTO cont circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(ak) Establish the right-hand weight switch operated relays in the 'in-flight' position by tripping the RH UC WEIGHT SW 'B' SYS SUP circuit breaker G294 on panel 3-213, map ref.B9; ensure that all services adversely affected by this condition are isolated (Ref. 7-11-00). Fit a safety clip to the tripped circuit breaker.

(al) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the emergency generator SELECTED and FAIL captions are illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(am) Establish the right-hand weight switch operated relays in the 'ground' condition by removing the safety clip and resetting the circuit breaker tripped in operation (ak). Check that the emergency generator SELECTED and FAIL captions remain illuminated and that the voltage indicated on the voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(an) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(ao) Ensure that the weight switch relay controlled services isolated in accordance with the provisions of operations (ae) and (ak) are reinstated as required.

(ap) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER GEN MANL CONT circuit breaker X211 on

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panel 1-213, map ref.R9, and fit safety clips.

(aq) Disconnect and remove the d.c. voltmeter from the emergency generator hydraulic selector valve 'free' connector and reconnect the connector to the selector valve, ensuring that the mating surfaces are clean and undamaged.

(ar) Remove the safety clip and reset the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9.

(as) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the SELECTED and FAIL captions are extinguished and that Nos.1, 2, 3 and 4 essential/main isolate magnetic indicators display in-line.

After SB 24-023 For A/C 001-001,

(aa) Observe No.2 engine HP RPM (N2) indicator on the pilots' centre instrument panel, 6-211. Reset the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, checking that the pointer on No.2 engine HP RPM (N2) indicator moves up to and remains at a dial reading of approximately 65 per cent N2.

(ab) With the reading on No.2 engine HP RPM (N2) indicator at approximately 65 per cent N2, check that the emergency generator FAIL and SELECTED captions remain extinguished.

(ac) Repeat operations (n) and (o).

(ad) Return No.1 essential/main (NORM/EMERG) control switch to "NORM" and check that the correspondingly numbered essential/main isolate magnetic indicator returns to in-line and the correspondingly numbered AC ESS BUS caption is extinguished. Check that the emergency generator SELECTED and FAIL captions remain illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(ae) Trip the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12, and check that when the reading on No.2 engine HP RPM (N2) indicator falls below approximately 58 per cent N2, the emergency generator SELECTED and FAIL captions remain illuminated.

(af) Fit a safety clip to the circuit breaker tripped in operation (ae).

(ag) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and remain extinguished.

(ah) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(ai) Disconnect the throttle control system test set cable 2 connector from connector socket SKT 2 on No.2 engine main control amplifier and from connector socket PL 2 on the test set. Remove the test set, fit the captive protection caps to connector sockets SKT 2 on Nos.1 and 2 engine main control amplifiers and refit the panels removed to gain access to shelves 6-215 and 8-215.

(aj) Remove the safety clips and reset the ENG 1 MAIN THROT SUP circuit breaker 1K1 on panel 2-213, map ref.F12, and the ENG 2 MAIN THROT SUP circuit breaker 2K1 on panel 2-213, map ref.C12. Remove the warning placard placed in operation (1)(l).

(ak) Establish the left-hand weight switch operated relays in the 'in-flight' position by tripping the LH UC WEIGHT SW & DOWNLOCK 'B' SYS SUP circuit breaker G293 on panel 3-213, map ref.B8; ensure that all services adversely affected by this condition are isolated (Ref. 7-11-00). Fit a safety clip to the tripped circuit breaker.

(al) Check that the emergency generator mode switch is at AUTO.

(am) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the emergency generator SELECTED and FAIL captions are

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illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(an) Establish the left-hand weight switch operated relays in the 'ground' condition by removing the safety clip and resetting the circuit breaker tripped in operation (ak). Check that the emergency generator SELECTED and FAIL captions remain illuminated and that the voltage indicated on the voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(ao) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and that the voltage indicated on the voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(ap) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(aq) Establish the right-hand weight switch operated relays in the 'in-flight' position by tripping the RH UC WEIGHT SW 'B' SYS SUP circuit breaker G294 on panel 3-213, map ref.B9; ensure that all services adversely affected by this condition are isolated (Ref. 7-11-00). Fit a safety clip to the tripped circuit breaker.

(ar) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the emergency generator SELECTED and FAIL captions are illuminated and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(as) Establish the right-hand weight switch operated relays in the 'ground' condition by removing the safety clip and resetting the circuit breaker tripped in operation (aq). Check that the emergency generator SELECTED and FAIL captions remain illuminated and

that the voltage indicated on the voltmeter connected at the 'free' connector of the hydraulic selector valve is not less than 25 V.

(at) Set the emergency generator isolate switch to "ISOL" and then reset to "NORM". Check that the SELECTED and FAIL captions are extinguished and that the voltage indicated on the d.c. voltmeter connected at the 'free' connector of the hydraulic selector valve falls to zero.

(au) Ensure that the weight switch relay controlled services isolated in accordance with the provisions of operations (ak) and (aq) are reinstated as required.

(av) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9, and fit safety clips.

(aw) Disconnect and remove the d.c. voltmeter from the emergency generator hydraulic selector valve 'free' connector and reconnect the connector to the selector valve, ensuring that the mating surfaces are clean and undamaged.

(ax) Remove the safety clip and reset the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9.

(ay) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10. Check that the SELECTED and FAIL captions are extinguished and that Nos.1, 2, 3 and 4 essential/main isolate magnetic indicators display in-line.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

C. Emergency Generator Overheat Indication

<u>WARNING:</u> DURING THIS TEST, ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR

MUST NOT BE RUN.

(1) Prepare

(a) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9, and fit safety clips.

(b) Gain access to the emergency generator by opening access door 153 DB (Ref. 54-41-41) and disconnect the electrical connector (X200-A) from the emergency generator.

(c) Connect the two decade resistance boxes to the emergency generator 'free' connector (X200-A) so that one box is connected between pins A and B (bearing overheat sensing) and the other between pins G and H (stator overheat sensing). Set each box at 100 ohm.

(d) Make available electrical ground power as detailed in 24-41-00.

(e) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10.

(2) Test

(a) Set the emergency generator mode switch to "GRD BY-PASS" and check that the SELECTED and FAIL captions are illuminated.

(b) Progressively increase the resistance on the resistance box connected between pins A and B and check that the emergency generator O/HEAT caption and the master warning red ELEC caption are illuminated when the resistance is at a setting within the range 162 to 167 ohm.

(c) Gradually decrease the resistance setting of the decade box, checking that the emergency generator O/HEAT caption and the master warning caption are extinguished when the resistance is at a setting within the range 159 to 153 ohm.

(d) Repeat operations (b) and (c) as applied to the resistance box connected between pins G and H of connector X200-A.

(e) Reset the two decade resistance boxes to 100 ohm.

(f) Set the emergency generator isolation switch to "ISOL" and the mode switch to "AUTO". Check that the SELECTED and FAIL captions are extinguished and then set the isolation switch to "NORM".

(3) Conclusion

(a) Trip the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and fit a safety clip.

(b) Disconnect and remove the decade resistance boxes and reconnect the electrical connector to the emergency generator, ensuring that the mating surfaces are clean and undamaged. Refit the access door removed in operation (1)(b).

(c) Remove the safety clip and reset the EMER GEN AUTO CONT circuit breaker X212 on panel 3-213, map ref.G10, and the EMER GEN MANL CONT circuit breaker X211 on panel 1-213, map ref.R9.

(d) Switch off and disconnect electrical ground power as detailed in 24-41-00.

D. Differential Protection Current Transformers

CAUTION: DURING THE FOLLOWING TESTS ENSURE THAT ALL AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN AND EXTERNAL POWER MUST NOT BE CONNECTED TO THE AIRCRAFT.

NOTE: This test checks the integrity of the secondary windings of the current transformers that are incorporated, one set in the unit (X202) located in the emergency generator feeder lines and the other set in the emergency generator.

(1) Prepare

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Gain access to the emergency generator CPU by removing the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00).

(c) Loosen the clamp nut and disconnect the hold-down screw assembly from the CPU hold-down lug.

(d) Carefully withdraw the CPU from the junction box and shelf.

(2) Test

(a) Using the differential protection current transformer test supply and the testmeter, check each winding of the differential protection current transformer, X202, as follows.

a1) Ensure that the test supply is switched off.

a2) Using a suitable cable link, connect the testmeter in series between one terminal of the test supply and pin A6 of the emergency generator CPU connector, X201A, in the aircraft rack. Ensure that the testmeter is set to the range 0 to 1A.

a3) Using a suitable cable link, connect the other terminal of the test supply to pin A2 of the connector X210A to complete the test circuit for the phase A winding of the transformer.

a4) Switch on the test supply and increase meter sensitivity until a measurable deflection is obtained. Check that the value of measured current is 15($\pm$5) mA.

NOTE: If the current indicated on the meter rises rapidly to 500 mA as the test voltage is applied, a short circuit is indicated. If a current slightly higher than 20 mA is observed, a shorted turn in the current transformer secondary winding is indicated. A zero current reading indicates an open circuit.

a5) Switch off the test supply and lower the meter sensitivity to the 0 to 1 A range.

Disconnect the cable link from pin A2 and reconnect it to pin A23 of connector X201A to complete the test circuit for the phase B winding of the transformer.

a6) Repeat operation a4).

a7) Switch off the test supply and lower the meter sensitivity to the 0 to 1 A range. Disconnect the cable link from pin A23 and reconnect it to pin A33 of connector X201A to complete the test circuit for the phase C winding of the transformer.

a8) Repeat operation a4).

a9) Switch off the test supply. Disconnect the cable links from pins A6 and A33 of connector X201A.

(b) Using the differential protection current transformer test supply and the testmeter, check each winding of the differential protection current transformer in the emergency generator as follows:-

b1) Ensure that the test supply is switched off.

b2) Using a suitable cable link, connect the testmeter in series between one terminal of the test supply and pin A4 of the emergency generator CPU connector, X201A. Ensure that the testmeter is set to the range 0 to 1A.

b3) Using a suitable cable link, connect the other terminal of the test supply to pin A1 of the connector X201A, to complete the test circuit for the phase A winding of the transformer.

b4) Switch on the test supply and increase meter sensitivity until a measurable deflection is obtained. Check that the value of measured current is 12.5($\pm$2.5) mA.

NOTE: If the current indicated on the meter rises rapidly to 500 mA as the test voltage is applied, a short circuit is indicated. If a current

slightly higher than 15 mA is observed, a shorted turn in the current transformer secondary winding is indicated. A zero current reading indicates an open circuit.

b5) Switch off the test supply and lower the meter sensitivity to the 0 to 1 A range. Disconnect the cable link from pin A1 and reconnect it to pin A14 of connector X201A to complete the test circuit for the phase B winding of the transformer.

b6) Repeat operation b4).

b7) Switch off the test supply and lower the meter sensitivity to the 0 to 1 A range. Disconnect the cable link from pin A14 and reconnect it to pin A32 of connector X201A to complete the test circuit for the phase C winding of the transformer.

b8) Repeat operation b4).

b9) Switch off the test supply. Disconnect and remove the test supply, the test meter and the cable links.

(3) Conclusion

(a) Comply with the electrical safety precautions.

(b) Place the emergency CPU on the shelf and slide it back until the electrical connectors are fully engaged with the mating connectors of the shelf junction box.

(c) Engage the hold-down screw assembly with the CPU hold-down lug and secure the clamp nut. Ensure that the CPU is bonded in accordance with 20-27-11.

(d) Fit the rear vestibule LH electronic racking forward and rear bulkheads (Ref. 25-71-00).

(e) Cancel the electrical isolation precautions taken in operation (1)(a), i.e., remove the warning notices.

(f) Carry out the test detailed in paragraph F.,

'Final - Main Engines Running'.

E. Emergency Generator Operation and Power Distribution

CAUTION: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THIS TEST.

(1) Prepare

(a) Check that all a.c. supplies are inhibited and that d.c. power is switched off.

(b) Open circuit breaker panel 1-213 to permit observation of the 'power on' neon indicator lamps that are mounted together on a panel at the end of shelf 12-215 and identified in Table 501.

NEON LAMP	'POWER ON' INDICATION
1X233	No.1 engine relight busbar
2X233	No.2 engine relight busbar
3X233	No.3 engine relight busbar
4X233	No.4 engine relight busbar
X232	Emergency generator

Neon Indicator Lamps on Panel at End of Shelf 12-215
Table 501

(c) Open circuit breaker panels 2-213 and 4-213 to permit observation of the neon indicator lamps that are mounted on the inner face of each panel and identified in Table 502.

NEON LAMP	PANEL	'POWER ON' INDICATION
1X136	2-213	No.1 a.c. essential busbar
2X136	2-213	No.2 a.c. essential busbar
3X136	4-213	No.3 a.c. essential busbar

NEON LAMP	PANEL	'POWER ON' INDICATION
4X136	4-213	No.4 a.c. essential busbar

Neon Indicator Lamps on Panels 2-213 and 4-213
Table 502

(d) Remove the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00) to permit access to the emergency generator control and protection unit (X201) on shelf 5-243.

(e) Make available electrical ground power as detailed in 24-41-00.

(f) Connect and supply ground hydraulic power to the green hydraulic system (Ref. Chap.29).

(g) Press the FAIL and O/HEAT captions, in turn, and check that each one is illuminated when pressed and is extinguished when released.

NOTE: The CPU reset facility is also energized when the FAIL caption is pressed.

(2) Test

(a) Set BATT A and BATT B control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line. Check also that the d.c. essential/main split magnetic indicators display in-line.

(b) Ensure that the EMERG RELIGHT BUSBAR selector switch on the engine starting panel (18-214) is set to OFF.

(c) Refer to Table 501 and check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are lit.

(d) Refer to Table 502 and check that Nos.1, 2, 3 and 4 a.c. essential busbar 'power on' neon indicator lamps are lit.

(e) Set the AC FREQ/VOLTS selector switch on the electrical generating control panel to "EMERG PWR".

(f) Set No.1 essential/main (NORM/EMERG) control switch to "EMERG" and check that No.1 essential/main isolate magnetic indicator displays cross-line and No.1 AC ESS BUS caption is illuminated.

(g) Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator commences running, by observing the voltage and frequency indications on the associated meters (approx. 115 V 400 Hz). Check also that -

g1) the emergency generator SELECTED caption is illuminated,

g2) the emergency generator FAIL caption is not illuminated, and

g3) No.1 AC ESS BUS caption is extinguished.

(h) Set No.1 essential/main (NORM/EMERG) control switch to "NORM" and check that No.1 essential/main isolate magnetic indicator displays in-line, that NO.1 AC ESS BUS caption is extinguished, but that the emergency generator continues to run, by observing the voltage and frequency indications on the associated meters.

(i) Set the emergency generator isolate switch to "ISOL" and then set the emergency generator mode switch to "AUTO". Check that the emergency generator ceases running, by observing that the voltage and frequency indications fall to zero, then reset the isolate switch to "NORM".

(j) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "EMERG" and check that Nos.1, 2, 3 and 4 AC ESS BUS captions are illuminated.

(k) Set the emergency generator mode switch to "MANUAL" and check that the emergency generator commences running, by observing the voltage and frequency indications on the associated meters (approx. 115 V 400 Hz). Check also that -

k1) the emergency generator 'power on' neon indicator lamp is lit (Ref. Table 501),

k2) the emergency generator FAIL caption is not illuminated,

k3) Nos.1 and 2 AC ESS BUS captions are extinguished, but Nos.3 and 4 AC ESS BUS captions remain illuminated,

k4) an emergency generator load is indicated on the emergency generator kVA meter, and

k5) the emergency generator voltage and frequency indications are not fluctuating.

(l) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "NORM"; Nos.1, 2, 3 and 4 A/C ESS BUS captions must be extinguished.

NOTE: The following operations (m) to (r), inclusive, involve the use of switches, fitted at the front panel of the emergency generator control and protection unit, to test the generator trip function of the internal overvoltage protection and differential current protection circuits and to reset the fault indicators on the unit after operation. One of these switches (SW4) is of the push-button type, the remainder (SW1, SW2, SW3 and SW5) are micro-switches which are operated by insertion of a suitable probe through the corresponding access hole.

(m) Locate switches SW4 and SW2 on the emergency generator control and protection unit and observe the emergency generator indicators on the electrical generating control panel. Press switches SW4 and SW2, both together, hold both depressed for a period of not less than 1.5 s, then release both switches. Check that -

m1) the emergency generator is de-excited, by observing that the voltage and frequency indicators full to zero,

m2) the emergency generator FAIL caption is illuminated, and

m3) the overvoltage fault indicator on the emergency generator control and protection unit displays 0 V.

(n) Press-to-test the emergency generator FAIL caption to initiate the generator reset facility of the emergency generator control and protection unit. Check that -

n1) the emergency generator FAIL caption is extinguished, and

n2) the output of the emergency generator is reinstated, by observing that the voltage and frequency indications are correct (approx. 115 V 400 Hz).

(o) Press and then release the overvoltage fault indicator reset switch SW1 on the emergency generator control and protection unit and check that the 0 V display disappears.

(p) Locate switches SW4 and SW3 on the emergency generator control and protection unit and observe the emergency generator indicators on the electrical generating control panel. Press switches SW4 and SW3 both together, then release both switches without delay. Check that -

p1) the emergency generator is de-excited, by observing that the voltage and frequency indications fall to zero,

p2) the emergency generator FAIL caption is illuminated, and

p3) the differential protection fault indicator on the emergency generator control and protection unit displays DP.

(q) Press-to-test the emergency generator FAIL caption to initiate the generator reset facility of the emergency generator control and protection unit. Check that -

q1) the emergency generator FAIL caption is extinguished, and

q2) the output of the emergency generator is reinstated, by observing that the

voltage and frequency indications are correct (approx. 115 V 400 Hz).

(r) Press and then release the differential protection fault indicator to reset switch SW5 on the emergency generator control and protection unit and check that the DP display disappears.

(s) Isolate Nos.1, 2, 3 and 4 engine relight busbars from main a.c. busbar supplies by tripping the circuit breakers listed below and fitting safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
NO.1 RELT NORM SUP	22-215	1X226	-
NO.2 RELT NORM SUP	21-215	2X226	-
NO.3 RELT NORM SUP	21-216	3X226	-
NO.4 RELT NORM SUP	22-216	4X226	-

(t) Refer to Table 501 and check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are extinguished.

(u) Refer to Table 501. Select positions "2", "4", "3" and "1", in turn, on the EMERG RELIGHT BUSBAR selector switch and check that as each busbar is selected, the correspondingly numbered engine relight busbar 'power on' neon indicator lamp is lit.

(v) Set the EMERG RELIGHT BUSBAR selector switch to "OFF" and check that all four engine relight busbar 'power on' neon indicator lamps (Ref. Table 501) are extinguished.

(w) Set the emergency generator isolate switch

to "ISOL" and then set the emergency generator mode switch to "AUTO". Check that the emergency generator ceases running, by observing that the voltage and frequency indications fall to zero, then reset the isolate switch to "NORM".

(3) Conclusion

(a) Remove the safety clips and reset the circuit breakers tripped in operation (2)(s). Check that Nos.1, 2, 3 and 4 engine relight busbar 'power on' neon indicator lamps are lit.

(b) Switch off and disconnect the ground hydraulic supply (Ref. Chap.29).

(c) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground supply on.

(d) Close and secure circuit breaker panels 1-213, 3-213 and 4-213.

(e) Refit the rear vestibule LH electronic racking forward and decor bulkheads (Ref. 25-71-00).

(f) Remove the warning placard from the ground power rig and disconnect electrical ground power as detailed in 24-41-00.

F. Final - Main Engines Running

(1) Prepare

(a) Trip the VOLTS/FREQ IND circuit breaker D211 on panel 23-215.

(b) Connect the precision-grade 110 to 125 V a.c. voltmeter and the precision-grade 350 to 450 Hz frequency meter between pins A and B of the a.c. test socket D116-A (AC BUSBAR VOLT) on panel 18-216 on the flight compartment right-hand racking.

(c) Reset the VOLTS/FREQ IND circuit breaker D211 on panel 23-215.

(d) Make available electrical ground power as detailed in 24-41-00.

(e) Ensure that the aircraft power unit installation and systems are cleared and safe for the ground running of all four engines to be carried out (Ref. Chap.71).

(f) With the four engines cleared for running but not started, check for connection of the engine speed unit signal output to the control circuit for the automatic selection of contingency rating as follows:-

f1) Set the engine throttle levers to the 'idle' position and check that the adjacent reheat selector switches are set to OFF.

f2) Set any one of the reheat selector switches to the 'on' (RHT) position.

f3) At the pilots' centre instrument panel, press (PUSH ARM) the T/O MONITOR arming push-switch and check that the CTY (contingency) caption light flashes on and off continually.

f4) Return the reheat selector switch, set at RHT, to "OFF" and check that the CTY caption is extinguished.

f5) Pull out the T/O MONITOR arming push-switch (PULL INHIB).

(g) Ensure that all four generator control switches are set to ON.

(h) In readiness for engine starting, set BATT A and BATT B control switches to "ON", checking that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(2) Test

(a) Start and run No.1 engine at a speed above 62 per cent N2, noting the procedures to be carried out if excessive CSD OIL INLET temperature is indicated during the engine run (Ref. 71-00-00). Check that as the engine speed increases to 30 per cent N2, approximately, the associated START/RELIGHT switch on the engine starting panel returns to the centre-OFF position.

(b) With No.1 engine running at a speed above 62 per cent N2, check that the auto shed breaker (ASB) position magnetic indicator displays in-line.

(c) Repeat operation (a), in turn, for Nos.2, 3 and 4 engines.

(d) Check that Nos.1, 2, 3 and 4 generators are on line and supplying all main a.c. distribution busbars, by observing that -

d1) Nos.1, 2, 3 and 4 generator circuit breaker (GCB) position magnetic indicators display in-line, and

d2) Nos.1, 2, 3 and 4 AC MAIN BUS and Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished.

(e) Check that BATT A and BATT B control switches are at ON and the associated 'battery isolate' magnetic indicators display in-line.

(f) Set the AC FREQ/VOLTS selector switch to "EMERG PWR".

**ON A/C 001-005,

Before SB 24-023

NOTE: The following operations (g) to (n), inclusive, contain an emergency generator loading check. They also provide a convenient method of checking operation of the emergency generator automatic start and auto-shed breaker (ASB) control circuits, and the 26 V a.c. 'A' and 'B' main busbar load-shedding control circuits.

(g) Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator remains inoperative, i.e., the SELECTED caption is not illuminated.

(h) In preparation for emergency generator loading, ensure that all engine feed pumps are switched on.

(i) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "EMERG". Check

that the emergency generator starts running, i.e., the SELECTED caption is illuminated and the FAIL caption is not illuminated. Check also that -

i1) Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished, indicating that the output of the emergency generator is connected to the associated busbars via the 'A' and 'B' system emergency busbars,

i2) the emergency generator voltage and frequency are correct (approx. 115 V 400 Hz) and not fluctuating, and

i3) the 'A' and 'B' system 26 V a.c. main busbars are shed, by observing that the power supply failure warning flag is visible on the blue system quantity indicator and the yellow system quantity indicator on the hydraulic management panel.

(j) Select and switch on such additional aircraft services as may be necessary to achieve a minimum load of 15 kVA on the emergency generator as indicated on the EMERG GEN KVA meter. Check that -

j1) the correct voltage and frequency, 115(+3 -5) V 400(±10) Hz, are indicated on the test meters connected at the AC BUSBAR VOLT test socket,

j2) the emergency generator voltage and frequency indications are not fluctuating, and

j3) the voltage and frequency indications given on the aircraft meters are consistent with the indications given on the test meters.

NOTE: The calibration tolerances for the aircraft a.c. voltmeter and the aircraft frequency meter are as follows:-

A.c. voltmeter: not greater than 5 per cent of the

full scale deflection.

Frequency meter: ±1 per cent of the full scale deflection.

(k) Return Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "NORM". Check that the emergency generator SELECTED caption is extinguished and the emergency generator ceases running. Check also that power is restored to the 'A' and 'B' system 26 V main a.c. busbars, by observing that the power supply failure warning flag has disappeared from the blue hydraulic system quantity indicator and the yellow hydraulic system quantity indicator.

(l) Shut down No.1 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2, the emergency generator does not commence running, i.e., the SELECTED caption is not illuminated.

(m) Shut down No.2 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2 -

m1) the ASB position magnetic indicator changes from in-line to cross-line, and

m2) the emergency generator SELECTED caption is illuminated, followed by illumination of the FAIL caption after a short period.

NOTE: The pressurizing supply for the green hydraulic system is provided by No.1 and/or No.2 engine-driven pump(s). Thus, with shut-down of both Nos.1 and 2 engines, power to sustain operation of the emergency generator will be lost. Residual pressure in the system will, however, enable the emergency generator to start and run at normal operating speed for a short period, after which the decay of system pressure will result in generator run-down and illumination of the FAIL warning caption.

(n) Set the emergency generator mode switch to "AUTO", then set the emergency generator isolate switch to "ISOL". Return the emergency isolate switch to "NORM" and check that the SELECTED and FAIL captions are extinguished.

After SB 24-023 For A/C 001-001,

NOTE: The following operations, (g) to (o) inclusive, contain an emergency generator loading check. They also provide a convenient method of checking operation of the emergency generator automatic start and auto-shed breaker (ASB) control circuits and the 26 V a.c. 'A' and 'B' main busbar load-shedding control circuits.

(g) Check that the emergency generator mode switch is at AUTO and that the emergency generator SELECTED caption is not illuminated.

(h) In preparation for emergency generator loading, ensure that all engine feed pumps are switched on.

(i) Set Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "EMERG". Check that the emergency generator starts running, i.e., the SELECTED caption is illuminated and the FAIL caption is not illuminated. Check also that -

i1) Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished, indicating that the output of the emergency generator is connected to the associated busbars via the 'A' and 'B' system emergency busbars,

i2) the emergency generator voltage and frequency are correct (approx. 115 V 400 Hz) and not fluctuating, and

i3) the 'A' and 'B' system 26 V a.c. main busbars are shed, by observing that the power supply failure warning flag is visible on the blue system quantity indicator and the yellow system quantity indicator on the hydraulic management

panel.

(j) Select and switch on such aircraft services as can be used to impose a total load on the emergency generator of between 15 and 20 kVA as indicated on the EMERG GEN KVA meter. Check that -

j1) the correct voltage and frequency, 115(+3 -5) V 400(±10) Hz, are indicated on the test meters connected at the AC BUSBAR VOLT test socket,

j2) the emergency generator voltage and frequency indications are not fluctuating, and

j3) the voltage and frequency indications given on the aircraft meters are consistent with the indications given on the test meters.

NOTE: The calibration tolerances for the aircraft a.c. voltmeter and the aircraft frequency meter are as follows:=

A.c. voltmeter: not greater than 5 per cent of the full scale deflection.

Frequency meter: ±1 per cent of the full scale deflection.

(k) Return Nos.1, 2, 3 and 4 essential/main (NORM/EMERG) control switches to "NORM". Check that the emergency generator SELECTED caption remains illuminated and the emergency generator continues running. Check also that power is restored to the 'A' and 'B' system 26 V a.c. main busbars, by observing that the power supply failure warning flag has disappeared from the blue hydraulic system quantity indicator and the yellow hydraulic system quantity indicator.

(l) Set the emergency generator mode switch to GRD BY-PASS and check that the emergency generator SELECTED caption is extinguished

and the emergency generator ceases running.

(m) Shut down No.1 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2 the emergency generator does not commence running, i.e., the SELECTED caption is not illuminated.

(n) Shut down No.2 engine (Ref. Chap.71) and check that when the engine speed falls below 58 per cent N2 -

n1) the ASB position magnetic indicator changes from in-line to cross-line, and

n2) the emergency generator SELECTED caption is illuminated, followed by illumination of the FAIL caption after a short period.

NOTE: The pressurizing supply for the green hydraulic system is provided by No.1 and/or No.2 engine-driven pump(s). Thus, with shut-down of both Nos.1 and 2 engines, power to sustain operation of the emergency generator will be lost. Residual pressure in the system will, however, enable the emergency generator to start and run at normal operating speed for a short period, after which the decay of system pressure will result in generator run-down and illumination of the FAIL warning caption.

(o) Set the emergency generator mode switch to "AUTO", then set the emergency generator isolate switch to "ISOL". Return the emergency generator isolate switch to "NORM" and check that the SELECTED and FAIL captions are extinguished.

(3) Conclusion

(a) If not already effected, shut down Nos.1 and 2 engines (Ref. Chap.71).

(b) Shut down Nos.3 and 4 engines (Ref. Chap.71).

(c) Set BATT A and BATT B control switches to

"OFF".

(d) Switch off and disconnect electrical ground power as detailed in 24-41-00.

(e) Disconnect and remove the precision-grade a.c. voltmeter and frequency meter connected at the a.c. test socket D116-A.

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END OF THIS SECTION

NEXT

GENERATOR - REMOVAL/INSTALLATION

1. General

The emergency generator and the associated hydraulic drive are assembled, installed, tested and removed as a single integral unit (Ref. 24-12-11).

DIFFERENTIAL PROTECTION CURRENT TRANSFORMER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The transformer is located in the flight compartment LH equipment racking, at the forward end of panel 12-215 in the base of the upper rack structure, behind circuit breaker panel 15-215.

2. Differential Protection Current Transformer

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 60 to 70 lbf in (0.69 to 0.80 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Open circuit breaker panel 15-215.

C. Remove

(1) Disconnect the electrical connector from the transformer.

(2) Disconnect the feeder cables which pass through the transformer from the heavy duty terminal block forward of the transformer.

NOTE: Note the order of assembly of the cable ends on the terminal posts to ensure correct replacement.

(3) Remove the bolts and washers securing the transformer, free the phase A feeder cable from the adjacent instrument transformer and withdraw the transformer over the ends of the feeder cables.

D. Install

(1) Comply with the electrical safety precautions.

(2) With the transformer upright, M side facing aft and outboard and L side (connector side) facing forward and inboard, slide the transformer over the ends of the feeder cables on to its base. Phase A feeder should pass through the forward outboard end, phase B feeder through the centre and phase C feeder through the aft inboard end. Pass the phase A feeder through the adjacent instrument transformer. Check that cable routing is in accordance with the applicable wiring diagram.

(3) Secure the transformer with the bolts and washers; check that the transformer is bonded in accordance with 20-27-11.

(4) CAUTION: THE ASSEMBLY ORDER OF BUSBAR/CABLES TO A TERMINAL POST MUST BE BUSBAR FIRST, IF FITTED, FOLLOWED BY CABLES IN SIZE ORDER WITH THE LARGEST CABLE FIRST.

Connect the feeder cable ends to the heavy duty terminal block in the order of assembly previously noted and in accordance with the cable identifications and the applicable wiring diagram. Torque-load the terminals to between 60 and 70 lbf in (0.69 and 0.80 mdaN).

E. Conclusion

(1) Close and fasten circuit breaker panel 15-215.

R (2) Carry out an Emergency AC Generation Differential
R Protection Current Transformers Functional Test.
R (Ref. 24-22-00, Adjustment/Test).

CONTROL AND PROTECTION UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The control and protection unit (CPU) is contained within a 1/4 ATR short case mounted in the rear left-hand racking on shelf 5-243. The front of the case incorporates a handle, to facilitate removal and installation, and a hold-down lug; an associated screw assembly attached to the shelf secures the unit to its mounting. Electrical connections are made through a double connector at the rear of the CPU.

2. Control and Protection Unit

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Set the emergency generator isolate switch to "ISOL" and check that the mode switch is at AUTO.

(2) Electrically isolate the control and protection unit by tripping the circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
EMERG GEN MANL CONT	1-213	X211	R9
EMERG GEN AUTO CONT	3-213	X212	G10

(3) Ensure that the emergency generator SELECTED caption is extinguished.

C. Remove

(1) Gain access to the CPU by removing the decor bulkhead and the forward bulkhead from the rear vestibule LH electronic racking (Ref. 25-71-00).

(2) Loosen the clamp nut and disconnect the hold-down screw assembly from the CPU hold-down lug.

(3) Carefully withdraw the CPU from the junction box and shelf.

RB (4) Examine rack and unit connectors for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts
RB and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

D. Install

(1) Comply with the electrical safety precautions.

RB (2) Examine unit connector for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts
RB and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

(3) Place the CPU on the shelf and slide it back until the electrical connectors are fully engaged with the mating connectors of the shelf junction box.

(4) Engage the hold-down screw assembly with the CPU hold-down lug and secure the clamp nut. Ensure that the CPU is bonded in accordance with 20-27-11.

E. Conclusion

(1) Fit the rear vestibule LH electronic racking forward and rear bulkheads (Ref. 25-71-00).

(2) Remove the safety clips and reset the circuit breakers tripped before removal.

(3) Set the emergency generator isolate switch to "NORM".

(4) Carry out an Operational Test of the CPU (Ref. Adjustment/Test).

CONTROL AND PROTECTION UNIT - ADJUSTMENT/TEST

CAUTION: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

OBSERVE THE HYDRAULIC SAFETY PRECAUTIONS DETAILED IN CHAPTER 29.

1. General

The following Operational Test, using hydraulic ground power, confirms that the control and protection unit (CPU) is correctly installed and proves its operation in the system. The test is primarily intended to check the unit after installation; Functional and System Tests are not considered necessary in this application.

2. Operational Test

A. Prepare

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Connect and supply ground hydraulic power to the green hydraulic system as detailed in Chapter 29.

B. Test

(1) Set the AC FREQ/VOLTS selector switch to "EMERG PWR".

(2) Set Nos.1 and 2 essential/main (NORM/EMERG) switches to "EMERG".

(3) Set the emergency generator mode switch to "GRD BY-PASS" and check that an emergency generator load is indicated and that voltage and frequency are correct (approx. 115 V 400 Hz) and the indication steady, i.e., not fluctuating. Check that the SELECTED caption is illuminated.

NOTE: An initial FAIL indication before the emergency generator starts is acceptable.

(4) Set Nos.1 and 2 essential/main (NORM/EMERG) switches to "NORM".

(5) Set the isolate switch to "ISOL" and check that the emergency generator stops.

(6) Set the emergency generator mode switch to "AUTO" and reset the isolate switch to "NORM".

(7) Set the AC FREQ/VOLTS selector switch to "GRND PWR".

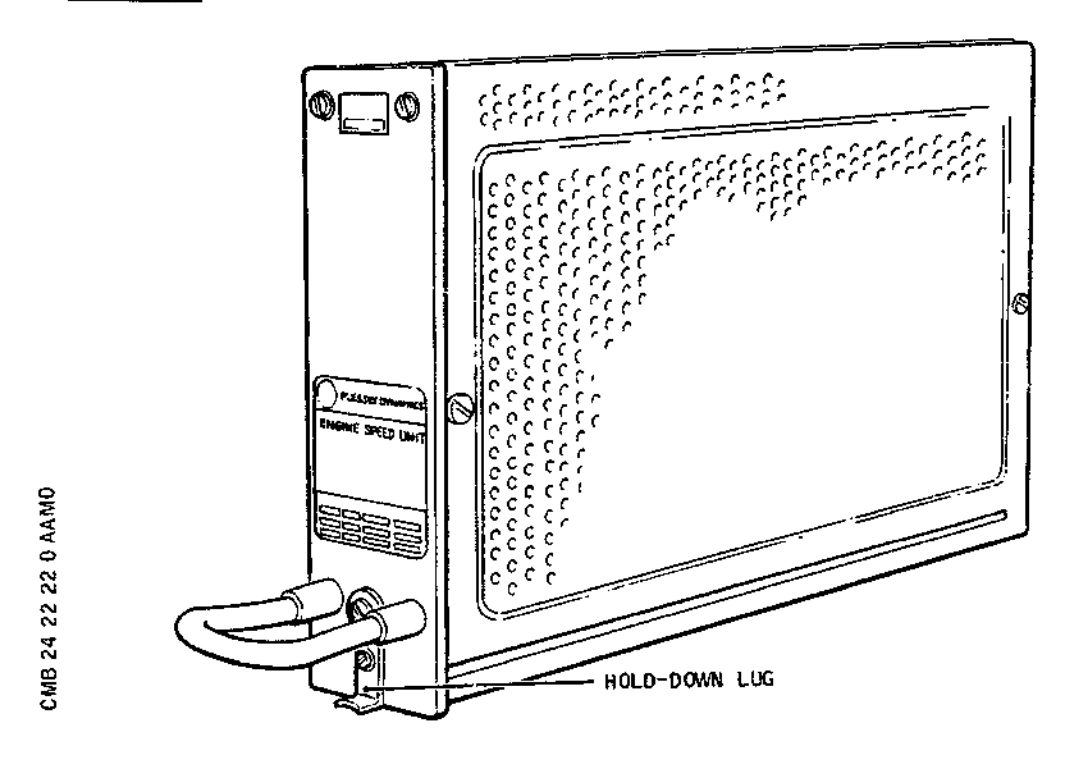
C. Conclusion

(1) Switch off and disconnect the ground hydraulic supply as detailed in Chapter 29.

(2) Switch off and disconnect electrical ground power as detailed in 24-41-00.

ENGINE SPEED UNIT - DESCRIPTION AND OPERATION

1. General (Ref. Fig.001 and 002)



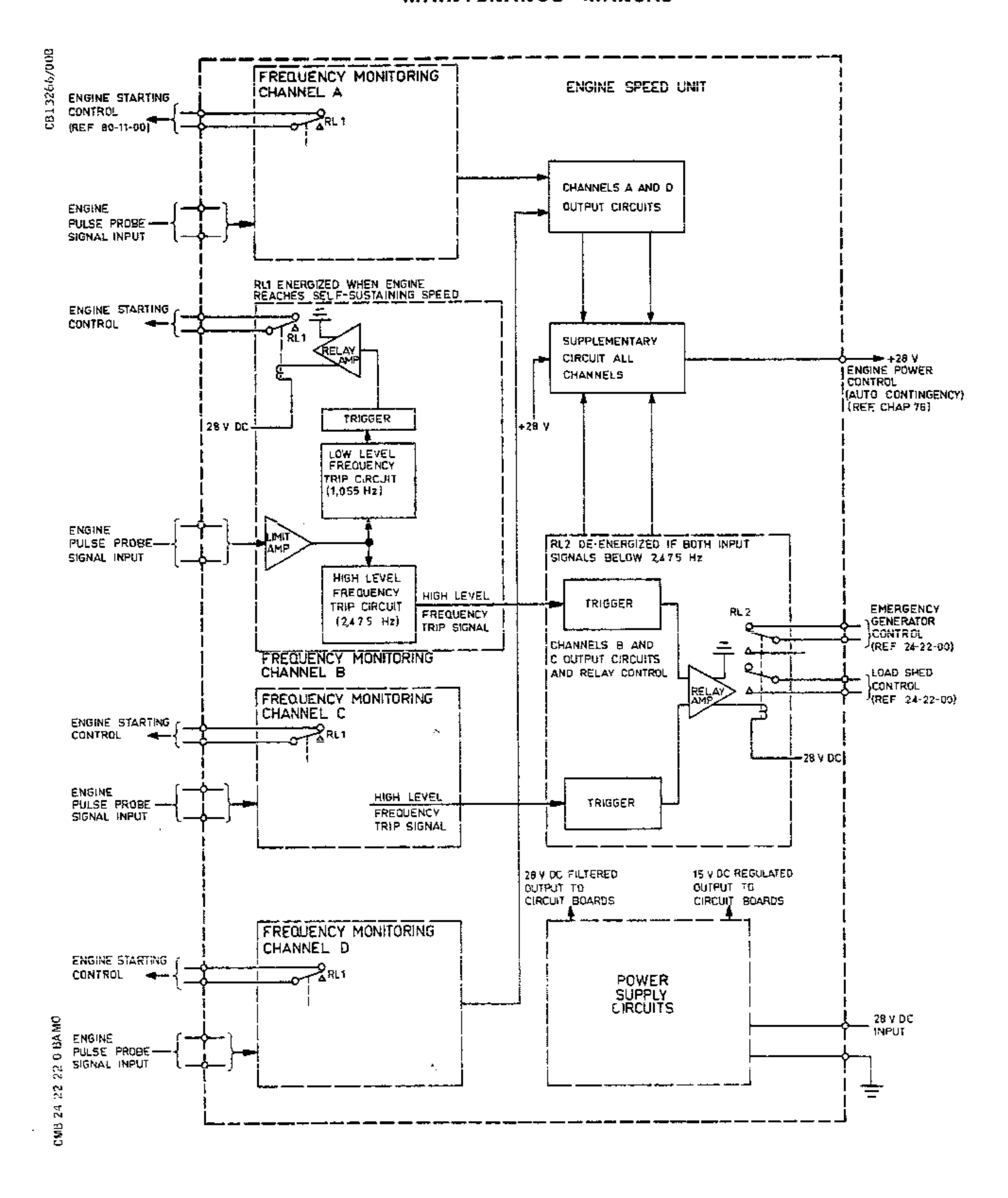
Engine Speed Unit
Figure 001

The engine speed unit monitors the frequency of signals from four engine-mounted pulse probe sensors, and provides control facilities for the operation of certain aircraft equipment.

The engine speed unit comprises solid state circuitry and relays mounted on printed circuit boards contained within a 1/4 ATR short case. The front of the case incorporates a handle to facilitate removal and installation, and a hold-down lug for clamping the unit to its mounting.

Electrical connections to the unit are made through an electrical connector at the rear of the case, and a hole in the back of the case provides access for a hold-down pin when the unit is clamped to its mounting.

The unit incorporates four identical frequency monitoring channels, each of which receives a frequency signal from



- Engine Speed Unit - Simplified Schematic
Figure 002

R

an associated engine-mounted probe sensor. The circuits associated with the four pulse probe sensors form frequency monitoring channels A, B, C and D and are mounted on printed circuit boards. The four circuit boards are identical in
R construction and operation, each containing a 1,055 Hz trip circuit, a 2,475 Hz trip circuit and a relay RL1, the contacts of which form part of the engine starting control
R circuit (Ref. 80-11-00). A supplementary circuit, mounted
R on its own circuit board, is connected to each of the four
R frequency monitoring channels. The circuit produces a
R 28 V d.c. control output for engine power control (auto
R contingency) if the signal input to any one of the four
R channels falls below 2,475 Hz (Ref. Chap.76).

Additional circuits, associated with the frequency monitoring channels B and C, are mounted on a printed circuit board, together with an associated relay (RL2). Normally-open contacts of this relay form part of the control circuit of the auto-shed breaker (ASB) and normally-closed contacts form part of the automatic control circuit of the emergency generator (Ref. 24-22-00).

Power supply circuits are mounted on a printed circuit board which is connected to an external 28 V d.c. supply.

2. Operation (Ref. Fig. 002)

A. Functional Description

(1) Engine Start-up

During a normal engine start, frequency monitoring channels A, B, C and D receive a frequency signal from the associated engine pulse probe sensors. All channels operate in a similar manner, therefore only one channel is described, as follows:-

(a) The input frequency signal, which is sine wave in form, is passed through a limiter amplifier to a low level frequency trip circuit consisting of a frequency detector and a comparator which provides an output when the
R frequency rises above 1,055 Hz, and to a high level frequency trip circuit consisting of a frequency detector and a comparator which provides an output when the input frequency rises above 2,475 Hz.

(b) During engine start-up, when the engine reaches self-sustaining speed, and the input
R signal frequency rises above 1,055(±15) Hz,

the comparator output from the low level frequency trip circuit initiates the switching of relay RL1 to terminate the engine starting
R cycle (Ref. 80-11-00). Under normal operating
R conditions when all channel signal frequencies
R are above 2,475 Hz, the supplementary circuit
R associated with engine power control (auto
R contingency) (Ref. Chap.76) is inoperative.
R If the signal frequency of any one channel
R drops below 2,475 Hz the circuit is triggered
R to connect the +28 V supply line from the
R circuit board to the unit output connector.

(2) Emergency Generator Control and Load Shed Control

When the engine associated with channel B or channel C is functioning normally, the input frequency signal is above 2,475 Hz. The comparator output from the high level frequency trip circuit provides a trip signal for relay RL2. In response to this signal, RL2 is energized, the control circuit for the ASB operating coil is completed and the ASB closes (Ref. 24-22-00).

If the signal frequencies at channels B and C both fall below 2,475(±25) Hz, the high level frequency trip signals are removed and relay RL2 is de-energized. In consequence -

(a) a normally-closed contact of relay RL2 opens, the control circuit supply for the ASB coil is interrupted and the ASB opens (Ref. 24-22-00), and

(b) a normally-open contact of relay RL2 closes, to initiate the automatic starting of the emergency generator (Ref. 24-22-00).

(3) Power Supplies

A 28 V d.c. supply is fed into filter and regulating networks to provide a 28 V d.c. filtered output, and a +15 V d.c. regulated output for relay control and channel monitoring circuit requirements. The frequency monitoring channel circuits also require a 12 V d.c. supply, which is obtained by dropping the regulated 15 V d.c. supply across a resistor on each of the frequency monitoring channel boards.

ENGINE SPEED UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The engine speed unit is contained within a 1/4 ATR short case mounted in the flight compartment left-hand racking on shelf 1-215. The front of the case incorporates a handle, to facilitate removal and installation, and a hold-down lug; an associated screw assembly attached to the shelf secures the unit to its mounting. Electrical connections to the unit are made through an electrical connector at the rear of the case and a hole in the rear of the case provides access for a hold-down pin when the unit is clamped to its mounting.

R 2. Engine Speed Unit

CAUTION: ENGINES MUST NOT BE RUN DURING THE FOLLOWING REMOVAL/ INSTALLATION PROCEDURES.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Place a warning placard in the flight compartment forbidding any attempt to start and run the engines.

(2) Electrically isolate the engine speed unit by tripping all the circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
NO.2 AND NO.3 EMER RELT BUS SELECT SUP	1-213	1X230	R10

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG 1 RH IGNITION CONT	1-213	1J2	N6
ENG 2 RH IGNITION CONT	1-213	2J2	P6
ENG 3 RH IGNITION CONT	1-213	3J2	Q6
ENG 4 RH IGNITION CONT	1-213	4J2	R6
EMER GEN AUTO CONT	3-213	X212	G10
ENG 1 LH IGNITION CONT	3-213	1J1	E1
ENG 2 LH IGNITION CONT	3-213	2J1	E2
ENG 3 LH IGNITION CONT	3-213	3J1	E3
ENG 4 LH IGNITION CONT	3-213	4J1	E4

C. Remove

(1) Gain access to the speed unit on shelf 1-215 by removing the appropriate panel from the left-hand racking.

(2) Loosen the clamp nut and disconnect the hold-down screw assembly from the speed unit hold-down lug.

(3) Carefully withdraw the speed unit from the junction box and shelf.

RB (4) Examine rack and unit connectors for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

D. Install

(1) Comply with the electrical safety precautions.

RB (2) Examine unit connector for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

(3) Place the speed unit on the shelf and carefully slide it back until the hold-down pin engages in the hold-down hole at the rear of the case, and the electrical connector is fully engaged with the mating connector of the shelf junction box.

(4) Engage the hold-down screw assembly with the speed unit hold-down lug and secure the clamp nut.

(5) Ensure that the engine speed unit is bonded in accordance with 20-27-11.

E. Conclusion

(1) Refit and secure the left-hand racking panel removed to gain access.

(2) Remove the safety clips and reset all circuit breakers tripped before removal.

(3) Remove the warning placard from the flight compartment.

(4) Carry out an Operational Test of the engine speed unit (Ref. Adjustment/Test).

ENGINE SPEED UNIT - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

R The following Operational Test is primarily intended to check an engine speed unit after installation to confirm that it is operating correctly in the system.

R Functional and System Tests are not considered necessary in this application.

2. Operational Test

A. Prepare

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Ensure that the aircraft power unit installation and systems are cleared and safe for the ground running of all four engines to be carried out (Ref. Chap.71).

B. Test

R (1) With the four engines cleared for running but not started, check for connection of the engine speed unit signal output to the control circuit for the automatic selection of contingency rating as follows:-

R (a) Set the engine throttle levers in the 'idle' position and check that the adjacent reheat selector switches are set to OFF.

R (b) Set any one of the reheat selector switches to the 'on' (RHT) position.

R (c) At the pilots' centre instrument panel, press (PUSH ARM) the T/O MONITOR arming push-switch and check that the CTY (contingency) caption light flashes on and off continually.

R (d) Return the reheat selector switch, set at RHT, to "OFF" and check that the CTY caption is extinguished.

R (e) Pull out the T/O MONITOR arming push-switch (PULL INHIB).

(2) Start and run No.1 engine at a speed above 62 per
R cent N2, noting the procedures to be carried out if
R excessive CSD OIL INLET temperature is indicated
R during the engine run (Ref. 71-00-00). As the engine
speed increases to 30 per cent N2, approximately,
R check that the associated START/RELIGHT switch on the
engine starting panel returns to the centre-off
position.

(3) Repeat operation (2) in turn for Nos.2, 3 and 4 engines.

R (4) Shut down Nos.2, 3 and 4 engines (Ref. 71-00-00).

(5) With No.1 engine exceeding 62 per cent N2, check that the auto-shed breaker (ASB) magnetic indicator displays in-line.

(6) Set the emergency generator mode switch to "GRD BY-PASS" and check that the emergency generator remains inoperative, i.e., the emergency generator SELECTED caption is not illuminated.

(7) Shut down No.1 engine so that the speed falls below 58 per cent N2 and check that -

(a) the emergency generator starts running,

(b) the emergency generator SELECTED caption is illuminated,

(c) the ASB magnetic indicator changes from in-line to cross-line, and

(d) the emergency generator FAIL caption is illuminated after a short period.

NOTE: The pressurizing supply for the green hydraulic system is provided by No.1 and/ or No.2 engine-driven pump. Thus, with shut-down of both No.1 and No.2 engines, power to sustain operation of the emergency generator will be lost. Residual pressure in the system will, however, enable the emergency generator to start and run at normal operating speed for a short period, after which the decay of system pressure will result in generator run-down and the illumination of the emergency generator FAIL warning caption.

R (8) Start No.2 engine, noting the procedures to be carried
R out if excessive CSD OIL INLET temperature is
R indicated during the engine run (Ref. 71-00-00).
R When the speed rises above 62 per cent N2, check that -

(a) the emergency generator is not running, i.e., the emergency generator SELECTED caption is extinguished,

(b) the emergency generator FAIL caption is extinguished, and

(c) the ASB magnetic indicator displays in-line.

(9) Repeat operation (7) as applied to No.2 engine.

C. Conclusion

(1) Return the emergency generator mode switch to "AUTO", then set the emergency generator isolate switch to "ISOL". Return the emergency generator isolate switch to "NORM" and check that the emergency generator SELECTED and FAIL captions are extinguished.

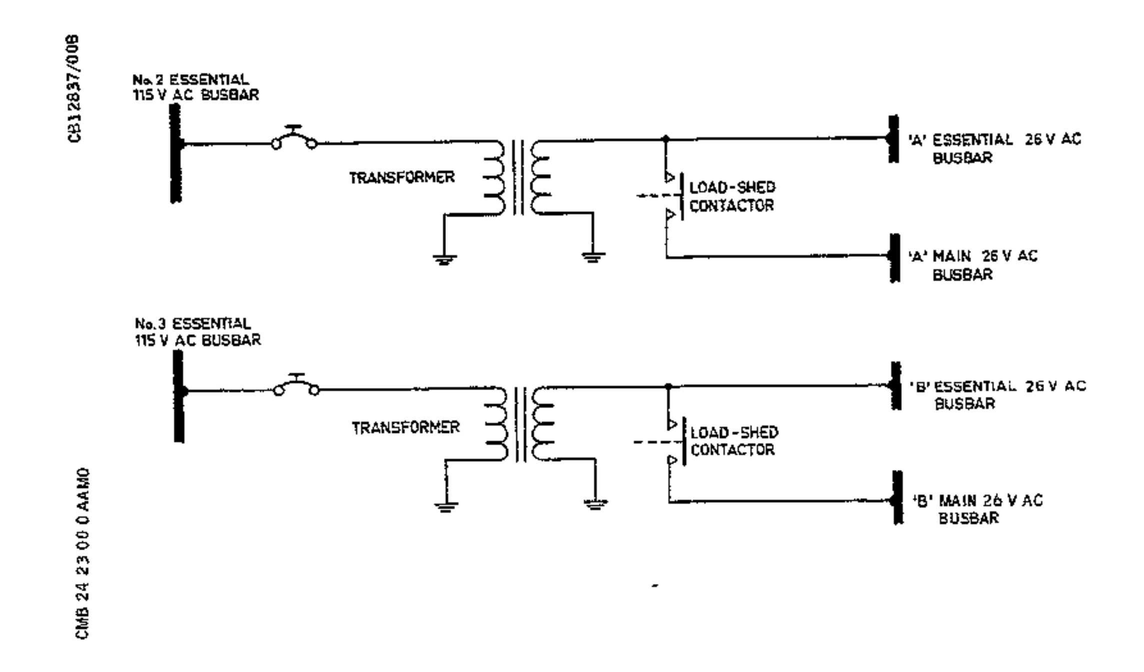
(2) Switch off and disconnect electrical ground power as detailed in 24-41-00.

26 V 400 Hz AC GENERATION - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

   26 V 400 Hz a.c. is generated by two 1,850 VA 115/26 V single-phase transformers, which supply the majority of the 26 V loads of the aircraft.

   The input of one transformer is taken from No.2 essential 115 V a.c. busbar (sub-system A) and that of the other from No.3 essential 115 V a.c. busbar (sub-system B). The transformer outputs are connected respectively to 'A' and 'B' essential 26 V a.c. busbars direct and, via the contacts of load-shed contactors, to 'A' and 'B' main 26 V a.c. busbars (Ref.24-51-00).



26 V 400 Hz AC Generation -
Electrical Schematic Diagram
R Figure 001

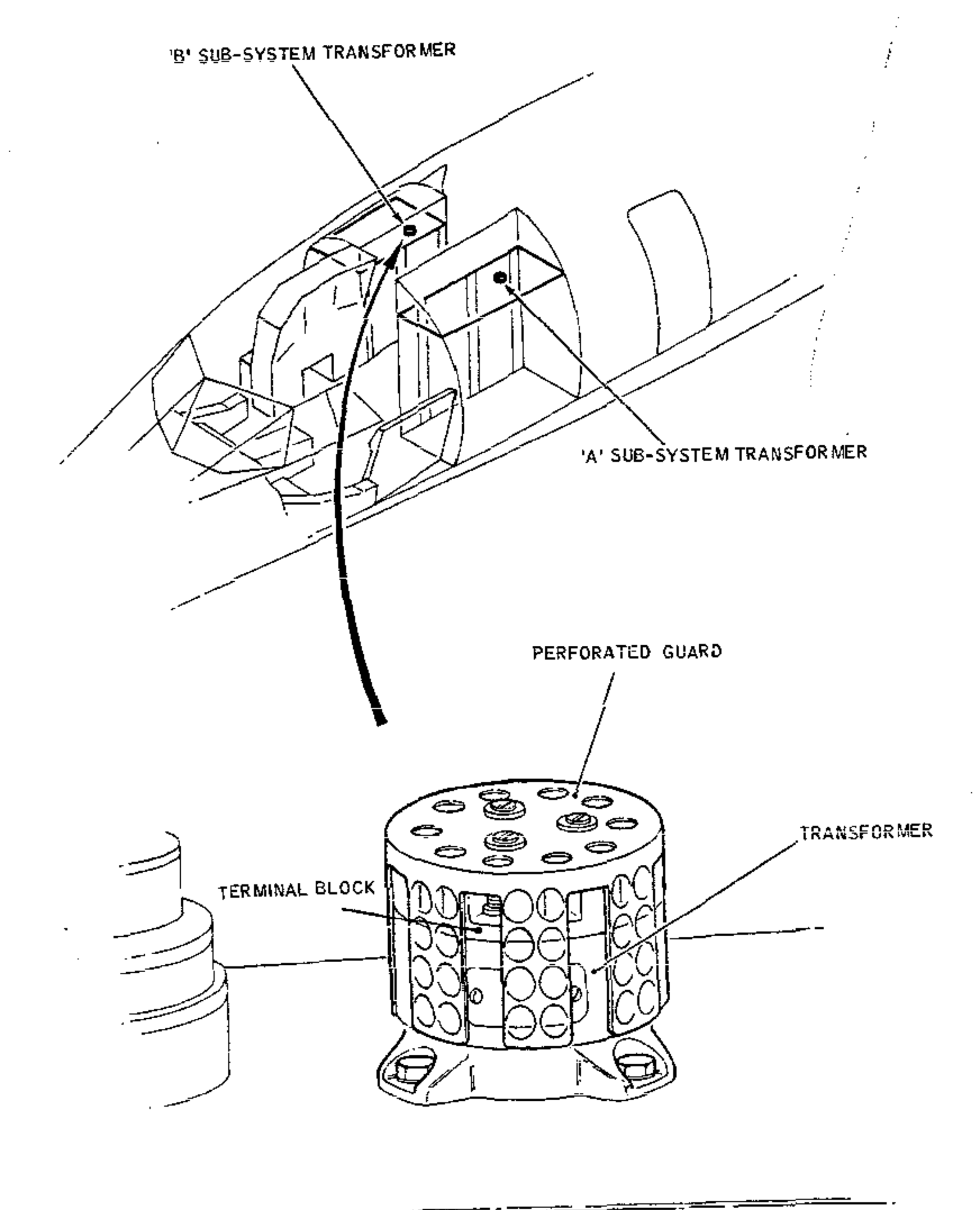
2. Transformers (Ref. Fig. 002)

R The transformers, each housed in a light-alloy case fitted
R with a terminal block and covered with a perforated guard, are
R mounted in the flight compartment racking, one on shelf 12-215
R and the other on shelf 12-216.

Mounting feet on the light-alloy case conduct heat from the windings to the aircraft structure, which therefore acts as a heat sink.

3. Operation

26 V a.c. is automatically available from the transformers whenever a supply is connected to Nos.2 and 3 essential 115 V a.c. busbars.



R Location of Transformers
Figure 002

26 V AC TRANSFORMER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Two 26 V a.c. transformers are associated with 26 V 400 HZ a.c. generation systems A and B. The A system transformer (1X132) is mounted in the flight compartment left-hand racking on shelf 12-215 and is positioned behind the hinged circuit breaker panel 14-215.

The B system transformer (2X132) is mounted in the flight compartment right-hand racking on shelf 12-216 and is positioned behind the hinged circuit breaker panel 13-216.
R Each transformer is secured by four bolts and electrical connections are made at terminals on top of each transformer case.

A transformer guard, not supplied by the transformer manufacturer, is fitted to each transformer. The screws and washers that secure the transformer guard and terminal cover replace the terminal cover securing screws fitted by the transformer manufacturer.

2. Transformer (Ref. Fig. 401)

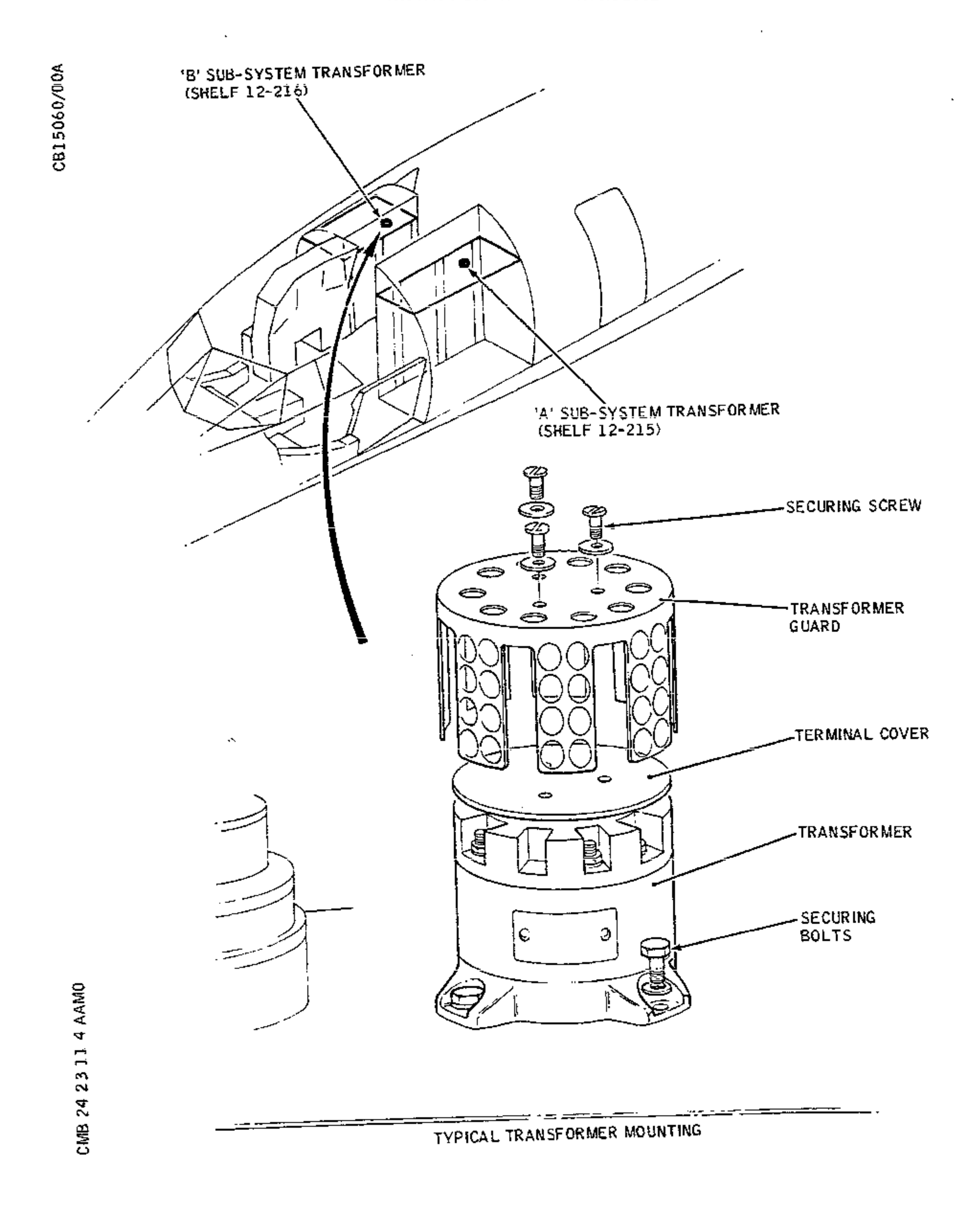
A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 23 to 25 lbf in (0.260 to 0.282 mdaN)	-
Torque spanner, 38 to 40 lbf in (0.429 to 0.452 mdaN)	-
Torque spanner, 40 to 45 lbf in (0.452 to 0.509 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Open circuit breaker panel 14-215 or 13-216, as applicable.



R 26 V AC Transformer - Installation
Figure 401

C. Remove

(1) Remove the transformer guard securing screws and washers. Withdraw the guard and the terminal cover. Retain the screws, washers and guard for use with a replacement transformer.

(2) Disconnect the cables from the transformer terminals.

(3) Remove the bolts and washers securing the transformer to the panel and withdraw the transformer.

D. Install

(1) Comply with the electrical safety precautions.

(2) Remove the securing screws, washers and the terminal cover from the replacement transformer; retain the terminal cover. Use the screws from the replacement transformer to secure the terminal cover of the removed transformer.

(3) Position the transformer mounting feet over the bolt holes in the panel. Secure the transformer with the bolts and washers. Torque-tighten the bolts to between 40 and 45 lbf in (0.452 and 0.509 mdaN). Check that the electrical bonding is in accordance with 20-27-11.

(4) Connect the cables to the transformer terminals in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminal nuts as follows:-

On 10-32 UNF terminal studs: to between 38 and 40 lbf in (0.429 and 0.452 mdaN).

On 8-32 UNC terminal studs: to between 23 and 25 lbf in (0.260 and 0.282 mdaN).

(5) Fit the terminal cover and the transformer guard and secure them with the screws and washers. Lock the screws in accordance with 20-25-11.

D. Conclusion

(1) Close circuit breaker panel 14-215 or 13-216, as applicable.

(2) Check on the oxygen pressure indicators on panel 7-214, at the third crew member's station, that the indicator flags on the dials display black and white stripes.

(3) Make available electrical ground power as detailed in 24-41-00.

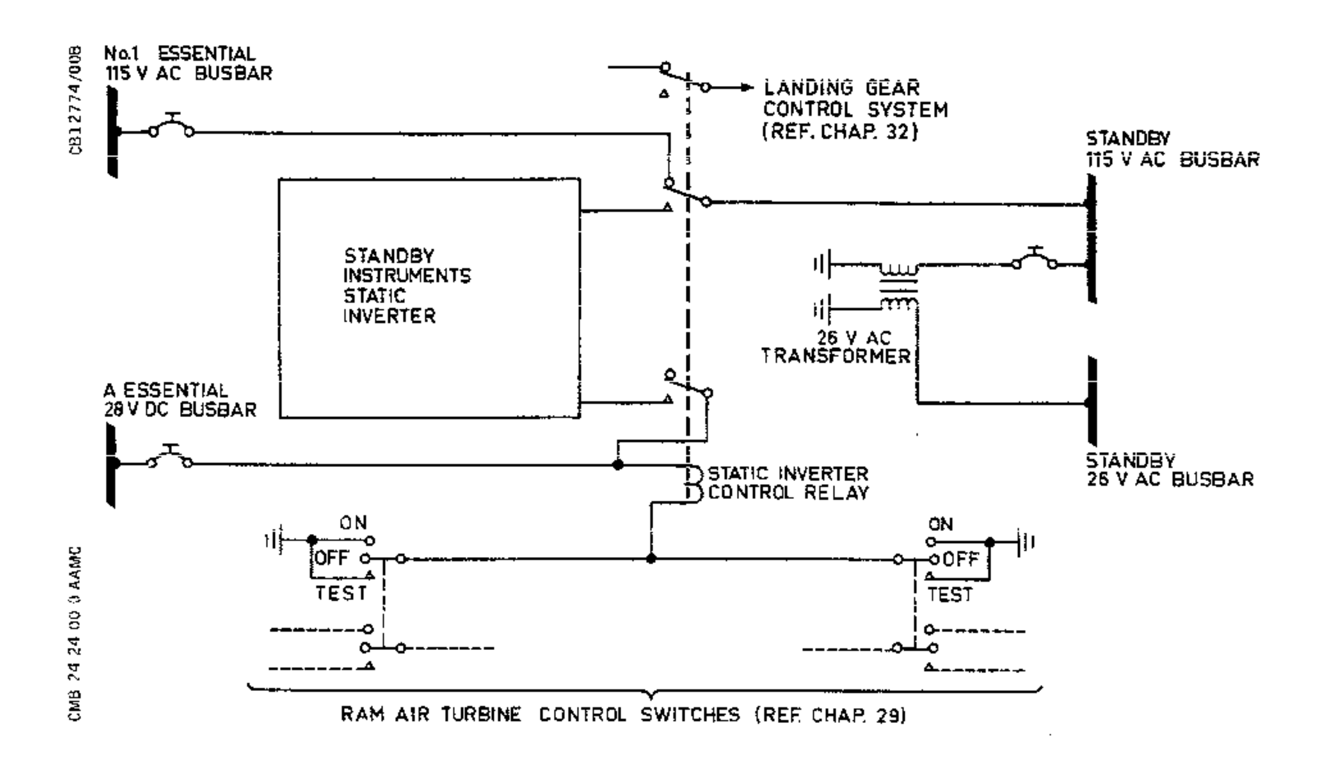
(4) Check that the indicator flags on the oxygen pressure indicators display black, indicating that a power supply is present.

<u>NOTE</u>: The single scale PASSENGER indicator proves the supply from the A system transformer on panel 12-215. The dual scale CREW and PASSENGER indicator proves the supply from the B system transformer on panel 12-216.

(5) Switch off and disconnect electrical ground power as detailed in 24-41-00.

STANDBY AC GENERATION - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)



- Standby AC Generation - Simplified Schematic
Figure 001

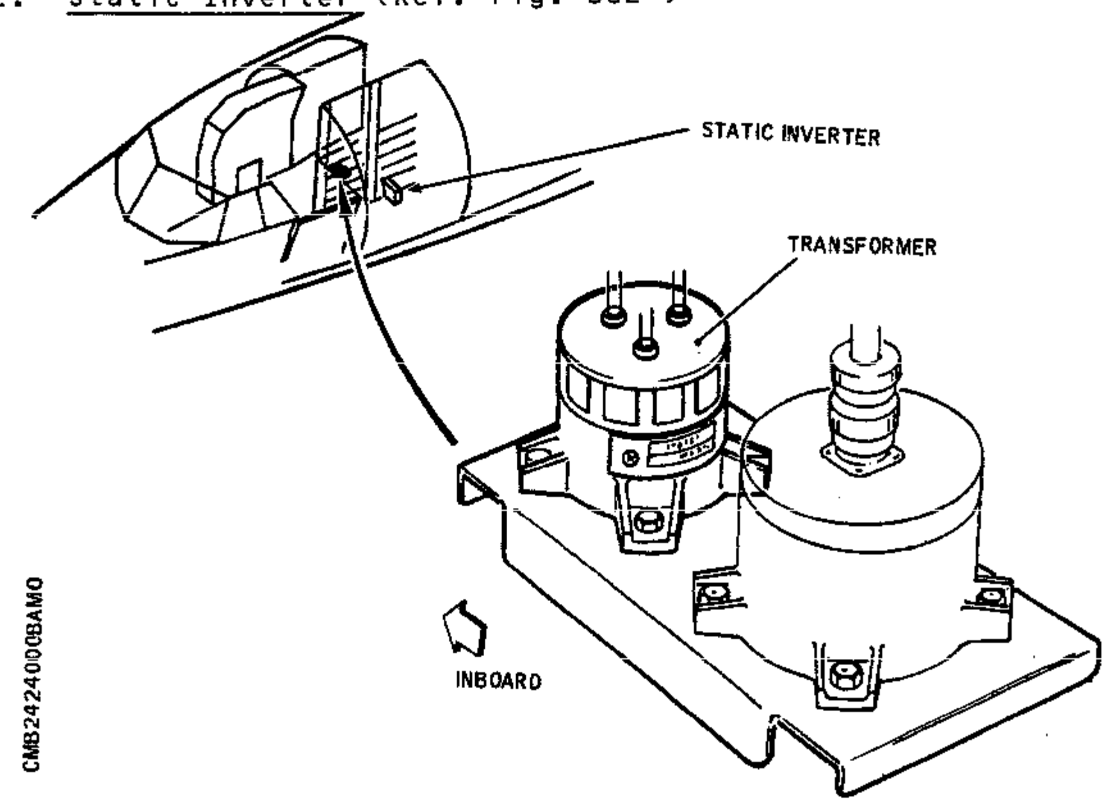
115 V single-phase 400 Hz a.c., generated by a static inverter from a 28 V d.c. essential busbar supply, is available as a standby source of power for certain essential services, i.e., radio altimeter and air data computer (Ref. Chap.34), under conditions necessitating use of the ram air turbine (Ref. Chap.29).

Control for the initiation of ram air turbine operation and change-over of the above-named essential services to static inverter power supplies, is combined by each of two ram air turbine control switches. Either switch may be used to initiate ram air turbine operation, the other providing a reserve capability. Each switch incorporates a common test facility for the associated control circuits.

The normal and standby power supplies to the affected services are distributed through a standby 115 V a.c.

busbar and a standby 26 V a.c. busbar (Ref. 24-51-00).

2. Static Inverter (Ref. Fig. 002)



Standby AC Generation - Equipment
Figure 002

The static inverter provides 250 VA 400 Hz at a regulated voltage of 115 V a.c. from a supply of 20 to 30 V d.c. It is mounted in the flight compartment left-hand racking on shelf 9-215 and is identified by an adjacent label - STANDBY INSTRUMENTS STATIC INVERTER.

3. Static Inverter Control Relay

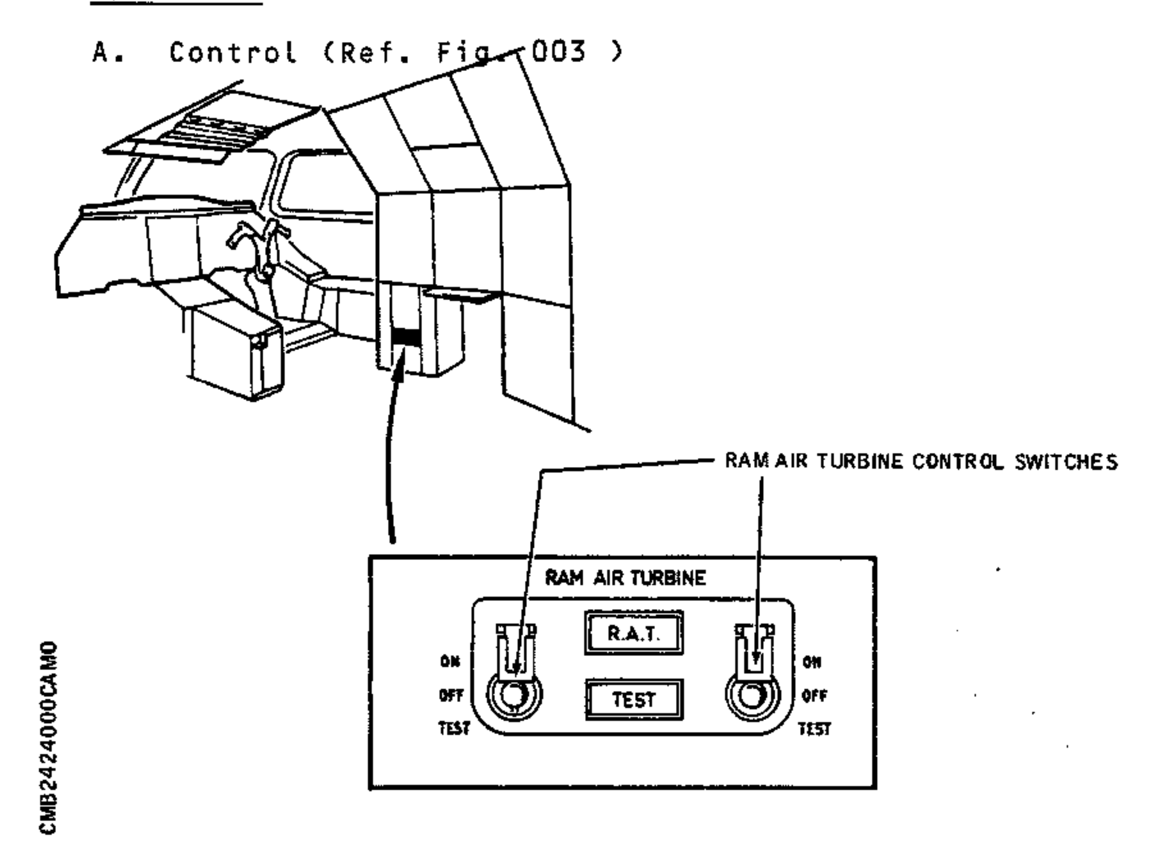
A static inverter control relay is mounted on the rear wall of the battery box (panel 19-215) in the flight compartment left-hand racking. The relay controls the power supplies to and from the static inverter and modifies operation of the landing gear control system while the ram air turbine is selected (Ref. Chap.32).

4. Transformer (Ref. Fig. 002)

A 100 VA 115/26 V single-phase a.c. transformer is mounted in the forward wall structure (panel 18-215) of the flight compartment left-hand racking, next to shelf 4-215. The transformer converts an input of approximately 115 V a.c. into an output of approximately 26 V a.c. to power the 26 V a.c. standby busbar.

5. Operation

A. Control (Ref. Fig. 003)



Standby AC Generation - Controls
Figure 003

Control for the change-over from normal to static inverter power supplies is a function of each of the two ram air turbine control switches located on the ram air turbine control panel, 14-214, at the third crew member's station.

Each switch has OFF, TEST and ON positions, and is guarded to prevent inadvertent operation to the ON position.

The TEST and ON positions of each switch are effective as follows:-

(1) TEST

(a) Tests the integrity of the associated (alternative) ram air turbine control circuit but does not permit extension of the ram air turbine to its operating position beneath the aircraft (Ref. Chap.29), and

(b) brings the standby instruments static inverter into operation and switches the standby 115 V a.c. busbar supply (and hence the standby 26 V a.c. busbar) from No.1 essential a.c. busbar to the static inverter output.

(2) ON

(a) Operates the associated (alternative) ram air turbine control circuit to initiate extension of the ram air turbine to its operating position beneath the aircraft (Ref. Chap.29),

(b) brings the standby instruments static inverter into operation in the same manner and with the same results as with the switch at TEST, and

(c) modifies operation of the landing gear control system to limit the transfer of hydraulic supplies during emergency lowering of the landing gear (Ref. Chap.32).

B. Functional Description (Ref. Fig. 001)

When either ram air control switch is set to ON or to TEST, the static inverter control relay is energized by a supply from the 'A' essential 28 V d.c. busbar. So operated, the relay -

(1) connects the same d.c. supply to the input terminal of the static inverter, thereby bringing the inverter into operation,

(2) disconnects the standby 115 V a.c. busbar from No.1 essential a.c. busbar and reconnects it to the output terminal of the static inverter, and

(3) interrupts the power supply to a landing gear control circuit (Ref. Chap.32).

The static inverter will then continue to supply the services connected to the standby 115 V a.c. busbar and, through the transformer, the standby 26 V a.c. busbar, providing a regulated output voltage of 115 V a.c. for as long as a satisfactory d.c. supply is present at the 'A' essential 28 V d.c. busbar.

When both ram air turbine control switches are set to OFF, the static inverter control relay is de-energized. Thus, the static inverter is electrically isolated and the standby 115 V a.c. busbar is connected to No.1 essential a.c. busbar, although the ram air turbine may have been extended to its operating position beneath the aircraft by previous operation of either ram air control switch to ON.

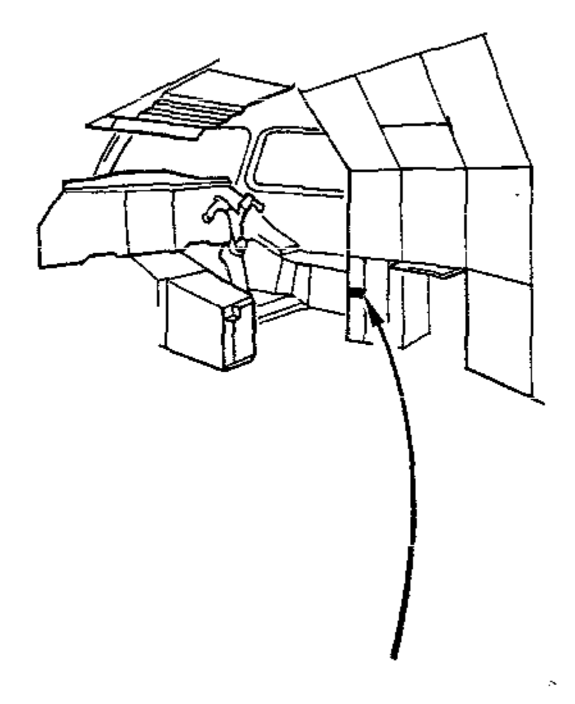
6. System Management (Ref. Fig. 004)

The standby a.c. generation system supplies alternative electrical power from a static inverter to certain essential services, i.e., the radio altimeter and the air data computer (ADC) when the ram air turbine (Ref. Chap.29) is selected.

Two switches, each controlling identical functions, are located on the ram air turbine control panel (14-214) and control extension of the ram air turbine and a simultaneous change-over from normal to standby a.c. for the associated services. The switches also provide a TEST facility and are guarded to prevent inadvertent operation to the ON position.

Both the ram air turbine and the a.c. standby system are ready for operation whenever electrical power is applied to the aircraft d.c. essential busbars.

CB12777/00A



RAM AIR TURBINE

R.A.T.

TEST

ON

OFF

TEST

RAM AIR TURBINE CONTROL SWITCHES

Switch to ON extends ram air turbine and effects change-over from normal to a.c. standby for radio altimeter and ADC.

Switch to TEST checks integrity of ram air turbine control circuits but does not initiate extension. Also effects same a.c. change-over action as ON.

CMB2424000DAM0

- Standby AC Generation - System Management
Figure 004

STANDBY AC GENERATION - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains instructions for the removal and installation of a static inverter control relay, associated with the standby a.c. generation system.

The control relay is mounted in the flight compartment LH racking on the outboard wall of 'A' system battery box (19-215). The relay is secured to a mounting plate by screws and washers, and electrical connections are made to screw-type terminals on top of the relay.

2. Static Inverter Control Relay (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Trip the 115 V AC ST'BY TRANS SUP circuit breaker X137, on panel 2-213, map ref.B22, and the STATIC INV SUP circuit breaker X138, on panel 1-213, map ref.N10, and fit safety clips.

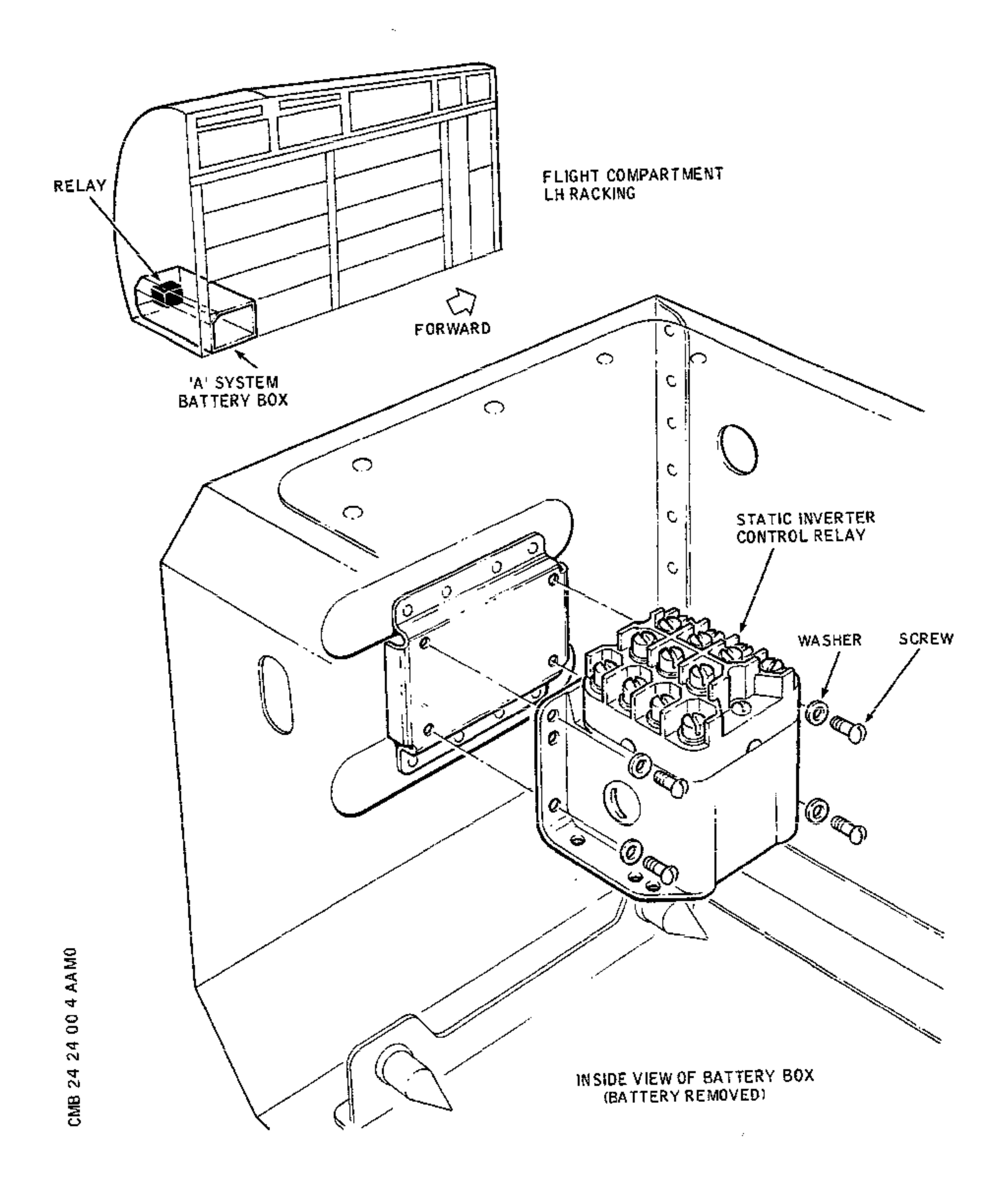
R CAUTION: OBSERVE THE LANDING GEAR SAFETY PRECAUTIONS
R DETAILED IN 32-00-00.

R (2) Trip the UC LOWER DOORS OPEN SUP circuit breaker
R G3, on panel 15-215, map ref.A8, and fit a
R safety clip.

R (3) Remove the appropriate sealing panel from the flight compartment LH racking (25-71-00) to uncover 'A' system battery box.

R (4) Remove the battery as detailed in 24-31-11 to gain access to the static inverter control relay on the outboard wall of the battery box.

C. Remove



- Static Inverter Control Relay - Installation
Figure 401

(1) Support the relay and remove the screws and washers securing the relay to its mounting plate. Tilt the relay inboard to gain easier access to the terminals.

(2) Disconnect the electrical cables from the terminals and withdraw the relay from the battery box.

D. Install

(1) Comply with the electrical safety precautions.

(2) Support the relay close to its mounting plate and connect the electrical cables to the relay terminals, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(3) Position the relay on its mounting plate with the terminal side facing up, and secure the relay to its mounting with the screws and washers.

E. Conclusion

(1) Install the battery as detailed in 24-31-11.

R (2) Remove the safety clips and reset the circuit
R breakers tripped in operation B.(1).

R CAUTION: OBSERVE THE LANDING GEAR SAFETY PRECAUTIONS
R DETAILED IN 32-00-00).

R (3) Remove the safety clip and reset the circuit
R breaker tripped in operation B.(2).

R (4) Check the operation of the static inverter control relay by carrying out the appropriate test procedure.

R (5) Install the flight compartment racking sealing panel in accordance with 25-71-00.

26 V AC TRANSFORMER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The 26 V a.c. standby transformer is secured to a mounting bracket situated on the aft face of the forward wall of the left-hand rack (18-215), near shelf 4-215. The transformer is secured at each of four integral mounting flanges by a screw and a washer. The screws are engaged by self-locking anchor nuts secured to the mounting bracket. Electrical connections to the transformer are made through four terminal studs that are anchored in the encapsulation and terminal block assembly. The terminal studs are protected by a detachable glass-fibre coverplate.

2. Transformer

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 5.0 to 5.5 lbf in (0.056 and 0.062 mdaN)	-

B. Prepare

(1) Electrically isolate the transformer by tripping all the circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
STATIC INV SUP	1-213	X138	N10
115 V AC ST'BY TRANS SUP	2-213	X137	B22
26 V AC ST'BY TRANS SUP	2-213	X134	C18

C. Remove

(1) Remove the appropriate rack sealing panel to gain access to shelf 4-215.

(2) Remove the pitch and azimuth computer units from shelf 4-215 (Ref. 22-13-11 and 22-12-11, respectively) to gain access to the transformer.

(3) Remove the terminal coverplate by removing the three screws, spring washers and plain washers.

(4) Remove the locknuts and disconnect the electrical cables secured to the terminal studs.

(5) Remove the four screws and washers securing the transformer to the mounting bracket.

(6) Remove the transformer and replace the terminal coverplate with the screws, spring washers and plain washers.

D. Install

(1) Comply with the electrical safety precautions.

(2) Remove the transformer terminal coverplate.

(3) Position the transformer on the mounting bracket and secure it with the four screws and washers.

(4) Connect the electrical cables to the transformer terminal studs, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Secure the cables with self-locking nuts torque-tightened to between 5.0 and 5.5 lbf in (0.056 and 0.062 mdaN).

(5) Reposition the terminal stud coverplate and secure it, using the three screws, spring washers and plain washers.

NOTE: It is recommended that all self-locking nuts and spring washers previously removed are discarded and replaced by new items.

(6) Ensure that the transformer is bonded in accordance with 20-27-11.

E. Conclusion

(1) Refit the pitch and azimuth computers in the appropriate rack assembly (Ref. 22-13-11 and 22-12-11, respectively).

(2) Refit the left-hand rack sealing panel removed to gain access.

(3) Remove the safety clips and reset all circuit breakers tripped before removal.

(4) Carry out a Functional Test as detailed in Adjustment/Test.

26 V AC TRANSFORMER - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The following Functional Test confirms that the 26 V a.c. transformer is correctly installed and proves its operation in the system. The test is primarily intended to check the unit after installation. A System Test is not considered necessary in this application; an Operational Test is not applicable.

2. Functional Test

WARNING: DURING THE FOLLOWING TEST PROCEDURES ENSURE THAT ALL AIRCRAFT-GENERATED AC SUPPLIES ARE INHIBITED, I.E., THE AIRCRAFT ENGINES AND EMERGENCY GENERATOR MUST NOT BE RUN.

A. Equipment and Materials

DESCRIPTION	PART NO.
A.c. voltmeter, range 0 to 30 V a.c.	-

B. Prepare

(1) Connect electrical ground power to the ground services distribution system only (Ref. 24-41-00, Servicing, para.2.A.).

(2) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(3) Open circuit breaker panel 2-213 to gain access to circuit breaker 1F88, map ref.B1.

(4) Connect the a.c. voltmeter between terminal 1 of the circuit breaker 1F88 and a convenient earth connection.

C. Test

(1) Remove the warning placard from the electrical generator control panel and connect electrical

ground power to the main a.c. distribution system (Ref. 24-41-00, Servicing, para.2.B.).

(2) Check the a.c. voltmeter for a reading of 26($\pm$0.5) V r.m.s.

D. Conclusion

(1) Disconnect electrical ground power from the main a.c. distribution system by setting the ground power control switch on the electrical generating control panel to "TRIP" and releasing it.

(2) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(3) Check that the 'power on' neon indicators on the inner face of circuit breaker panel 2-213 are extinguished, then disconnect and remove the a.c. voltmeter.

(4) Close and secure circuit breaker panel 2-213.

(5) Remove the warning placard from the electrical generating control panel. Switch off and disconnect electrical ground power as detailed in 24-41-00.

STATIC INVERTER 115 V AC - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The static inverter is contained in a light alloy framework that is panelled on all sides and is mounted in the flight compartment left-hand racking on shelf 9-215. Two handles are fitted to the front of the unit to facilitate removal and installation. The unit is secured to the shelf by locking levers contained one in each handle. Electrical connections are made through a connector fitted on the shelf back-plate.

2. Static Inverter 115 V AC

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare

(1) Electrically isolate the static inverter by tripping the circuit breakers listed below. Fit a safety clip to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
115 V AC ST'BY TRANS SUP	2-213	X137	B22
STATIC INV SUP	1-213	X138	N10

(2) Gain access to the static inverter by removing the appropriate panel from the flight compartment left-hand racking.

C. Remove

(1) Press down the button on top of each handle to release the locking levers. Withdraw the static inverter from the rack-mounted connector by pulling down the locking levers simultaneously.

(2) Withdraw the static inverter from the mounting rack.

(3) Replace the handle levers in the locked position.

RB (4) Examine rack and unit connectors for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket
RB contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts
RB and keyways.

RB <u>NOTE</u>: If connector is damaged refer to WDM 20-42-71.

D. Install

(1) Comply with the electrical safety precautions.

RB (2) Examine unit connector for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket
RB contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts
RB and keyways.

RB <u>NOTE</u>: If connector is damaged refer to WDM 20-42-71.

(3) Press down the button on the top of each of the static inverter handles and pull down the locking levers.

(4) Place the static inverter in the mounting rack and carefully push the unit in until the inverter connector mates with the corresponding connector on the mounting rack.

(5) Fold up the locking levers simultaneously, ensuring that the hook at the bottom of the locking lever engages with the associated catch on the mounting rack. Ensure that the unit is bonded in accordance with 20-27-11.

E. Conclusion

(1) Remove the safety clips and reset the circuit breakers tripped before removal.

(2) Carry out an Operational Test of the static inverter (Ref. Adjustment/Test).

(3) Replace the racking panel removed to gain accesss to the static inverter.

STATIC INVERTER 115 V AC - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The following Operational Test is primarily intended to check a static inverter after installation to confirm that it is operating correctly in the system. Functional and System Tests are not considered necessary in this application.

2. Operational Test

A. Prepare

(1) Make available electrical ground power as detailed in 24-41-00.

(2) Isolate the 115 V a.c. standby busbar from the 'normal' supply busbar (No.1 essential) by tripping the 115 V A.C. STBY TRANS SUP circuit breaker X137 on panel 2-213, map ref.B22. Fit a safety clip to the tripped circuit breaker.

(3) Locate No.1 radio altimeter on the captain's instrument panel (2-211). Check that the DH setting knob (marked with a triangle) on the altimeter is at the counter-clockwise stop and the black warning flag mask marked OFF is visible on the front face of the instrument.

B. Test

WARNING: THE CONTROL SWITCHES ON THE RAM AIR TURBINE (RAT) CONTROL PANEL ARE EACH GUARDED TO PERMIT OPERATION OF A SWITCH TO THE 'TEST' POSITION ONLY.

THESE GUARDS MUST NOT BE RAISED SINCE OPERATION OF EITHER SWITCH TO THE 'ON' POSITION WILL INITIATE THE AUTOMATIC EXTENSION OF THE RAM AIR TURBINE TO ITS OPERATIONAL POSITION BENEATH THE AIRCRAFT.

(1) On the ram air turbine control panel (14-214), set one of the two control switches to "TEST" and hold it at that position, checking that the adjacent TEST caption is illuminated.

(2) Check that the 115 V a.c. standby busbar is powered

by the output of the static inverter, by ensuring that No.1 radio altimeter system is thereby powered as follows:-

(a) On No.1 radio altimeter, rotate the DH setting knob clockwise to set the decision height index on the dial scale to 50 ft, checking that the black warning flag mask marked OFF disappears to reveal a red warning flag.

(b) Allowing 10 s for system warm-up, check that the red flag disappears.

(3) Release the ram air turbine control switch to "OFF" and check that the black warning flag marked OFF reappears, indicating that the static inverter power supply is removed from the 115 V a.c. standby busbar.

(4) Remove the safety clip and reset the circuit breaker tripped in operation A.(2). Check that the black warning flag marked OFF disappears, indicating that the 115 V a.c. standby busbar is reconnected to the 'normal' supply busbar.

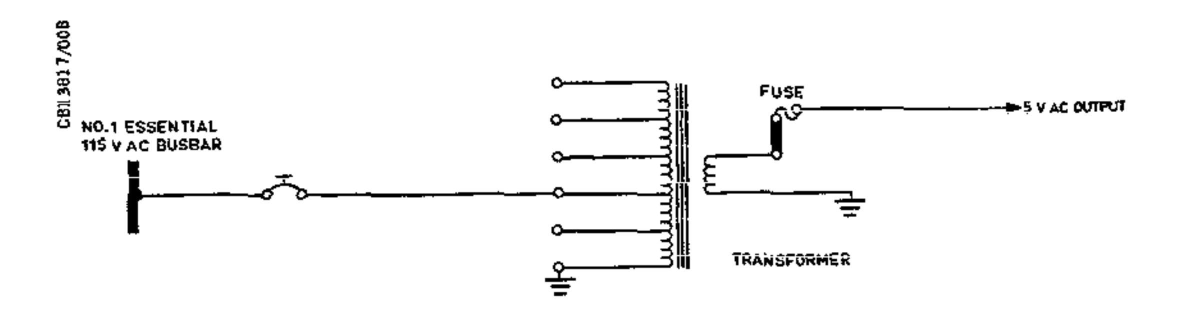
(5) Rotate the DH setting knob on No.1 radio altimeter to set the decision height index to zero.

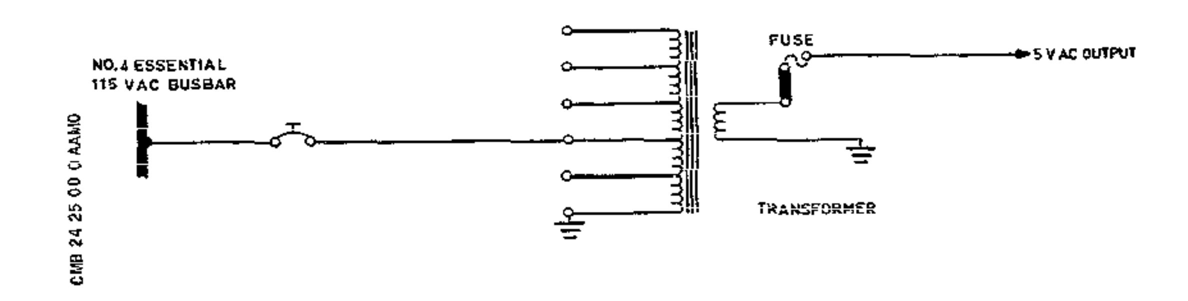
C. Conclusion

(1) Switch off and disconnect electrical ground power as detailed in 24-41-00.

5 V AC AVIONIC SUPPLIES - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)



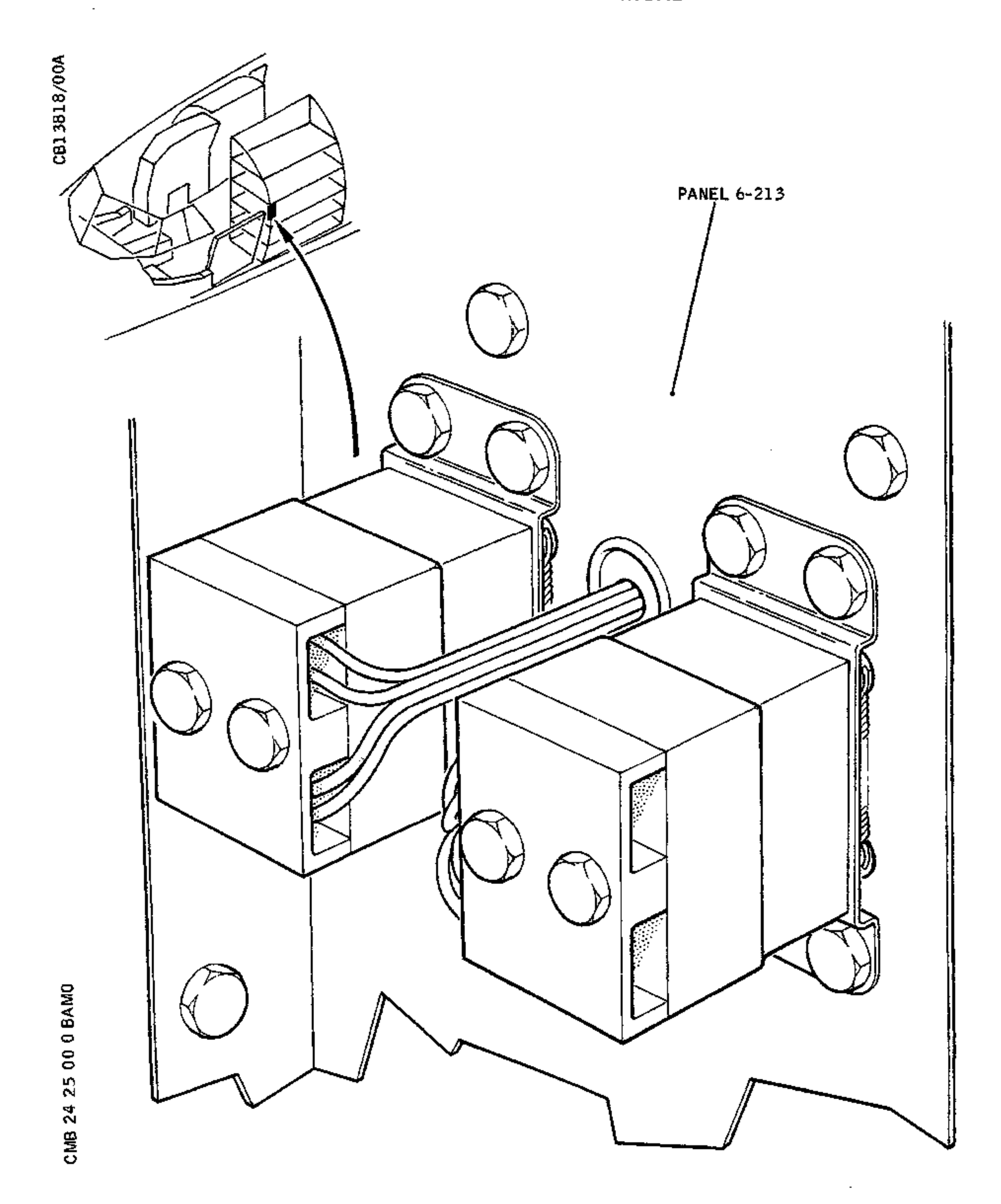


= 5 V AC Avionic Supplies - Simplified Schematic
R Figure 001

Two stepped-primary transformers, one supplied from No.1 essential 115 V a.c. busbar, the other from No.4 essential 115 V a.c. busbar (Ref. 24-51-00), provide a constant 5 V a.c.
R supply. This power supply is provisionally installed for
R use when equipment incorporating seven segment display
R heads is fitted. Both transformers are mounted on a panel (6-213) behind the flight compartment LH miscellaneous equipment rack.

2. Transformers (Ref. Fig. 002)

The primary winding of each transformer is stepped in five stages to give an output at the secondary winding of 2.5 V, 3.4 V, 4.2 V, 5.0 V or 5.9 V a.c. from a primary input of 115 V a.c. The output is protected by a fuse fitted in the transformer case and electrical connections are made at terminals on top of the transformer.



Location of Transformers
Figure 002

3. Operation

5 V a.c. is automatically available from the transformers whenever a supply is connected to No.1 and No.4 essential 115 V a.c. busbars.

R When the power supply is not required, the transformer
R input supply circuit breakers are locked in the trip
R position.

5 V AC TRANSFORMER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The two transformers are mounted on a panel, 6-213, located behind the flight compartment LH miscellaneous equipment rack. Each transformer is secured to a mounting plate by screws entering the transformer from the reverse side of the plate, the mounting plate being secured by screws to the panel. Electrical connections are made at terminals on top of each transformer, the terminals being protected by a terminal cover.

R **ON A/C 006-007,

2. 5 V AC Transformer (Ref. Fig. 401)

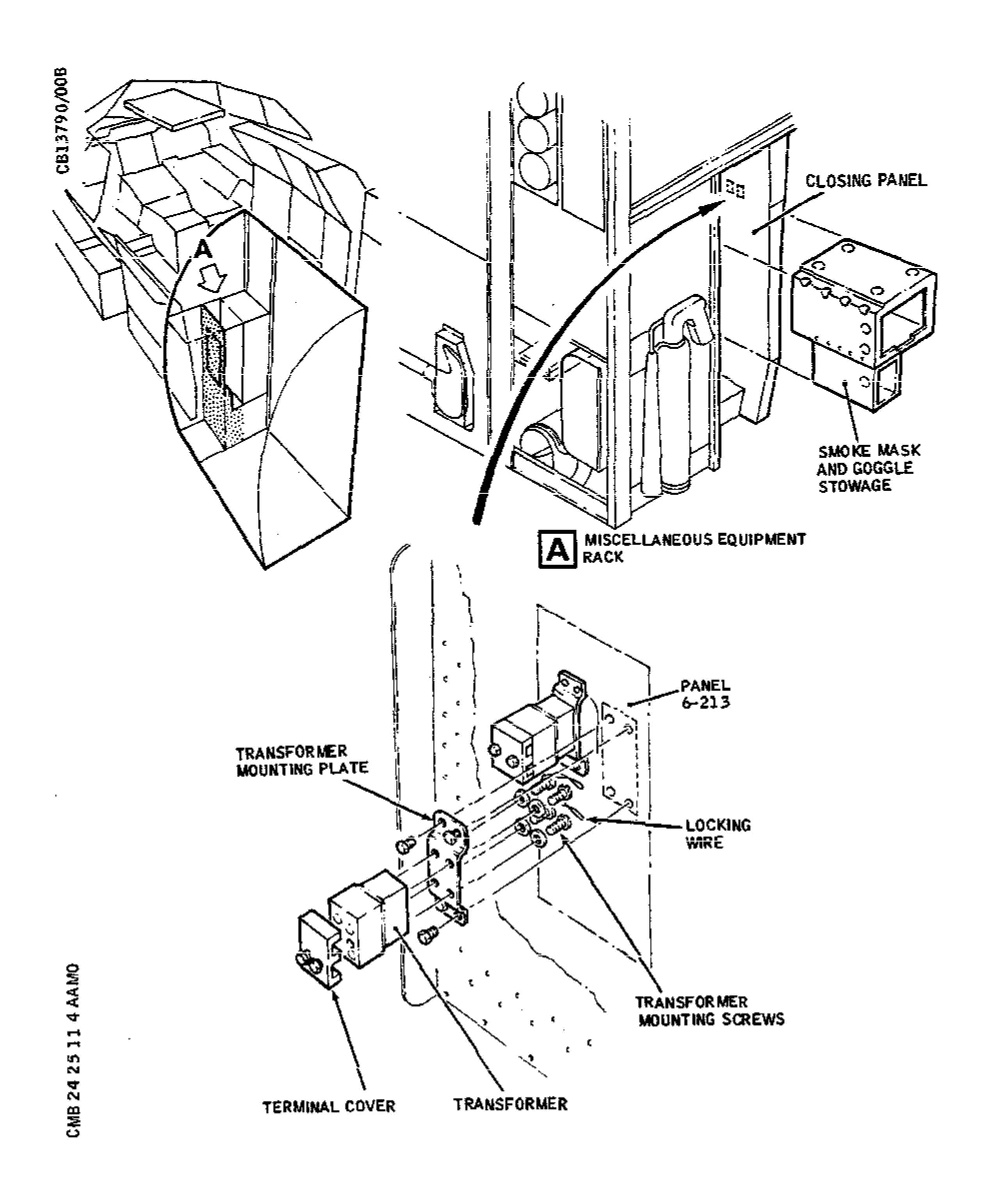
A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 3.5 to 4.0 lbf in (0.040 to 0.045 mdaN)	-
Torque spanner, 14.0 to 16.0 lbf in (0.16 to 0.18 mdaN)	-

B. Prepare

(1) Trip the circuit breakers listed below and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
5 V AC AVIONIC CONSTANT SUP 1	2-213	X550	B18
5 V AC AVIONIC CONSTANT SUP 2	4-213	X551	B14



- 5 V AC Transformer - Installation
R Figure 401

(2) Remove the smoke mask and goggle stowage compartment
R and closing panel from the LH miscellaneous equipment
R rack as required to gain access to the transformer (Ref. Chap.25).

C. Remove

(1) Remove the transformer terminal cover and disconnect the cables from the terminals.

(2) Refit the terminal cover.

(3) Remove the screws securing the transformer mounting plate to panel 6-213.

(4) Withdraw the mounting plate and transformer clear of the equipment rack.

(5) Cut the locking wire and remove the screws and washers securing the transformer to the mounting plate.

D. Install

(1) Comply with the electrical safety precautions.

(2) Position the transformer on its mounting plate and secure it with the screws and washers. Wire-lock the screws in accordance with 20-21-13.

(3) Position the mounting plate and transformer on panel 6-213 and secure it with the screws.

(4) Check that the transformer is bonded in accordance with 20-27-11.

(5) Remove the terminal cover from the transformer.

(6) Connect the electrical cables to the transformer terminals, ensuring that the connections are made in
R accordance with the cable identifications and the applicable wiring diagram.

R (7) Torque-tighten 4 UNC terminals to between 3.5 and 4.0 lbf in (0.040 and 0.045 mdaN) and 8 UNC terminals to between 14.0 and 16.0 lbf in (0.16 and 0.18 mdaN).

(8) Refit the terminal cover.

E. Conclusion

R (1) Refit the closing panel and the smoke mask and goggle
R stowage compartment (Ref. Chap.25) to the outboard wall of the equipment rack.

(2) Remove the safety clips and reset the circuit breakers tripped before removal.

(3) Make available electrical ground power as detailed in 24-41-00.

R (4) Ensure that the 5 V a.c. output is available,
R by carrying out the appropriate test of the associated system.

(5) Switch off and disconnect electrical ground power.

R

R **ON A/C 001-005,

2. <u>5 V AC Transformer</u> (Ref. Fig. 402)

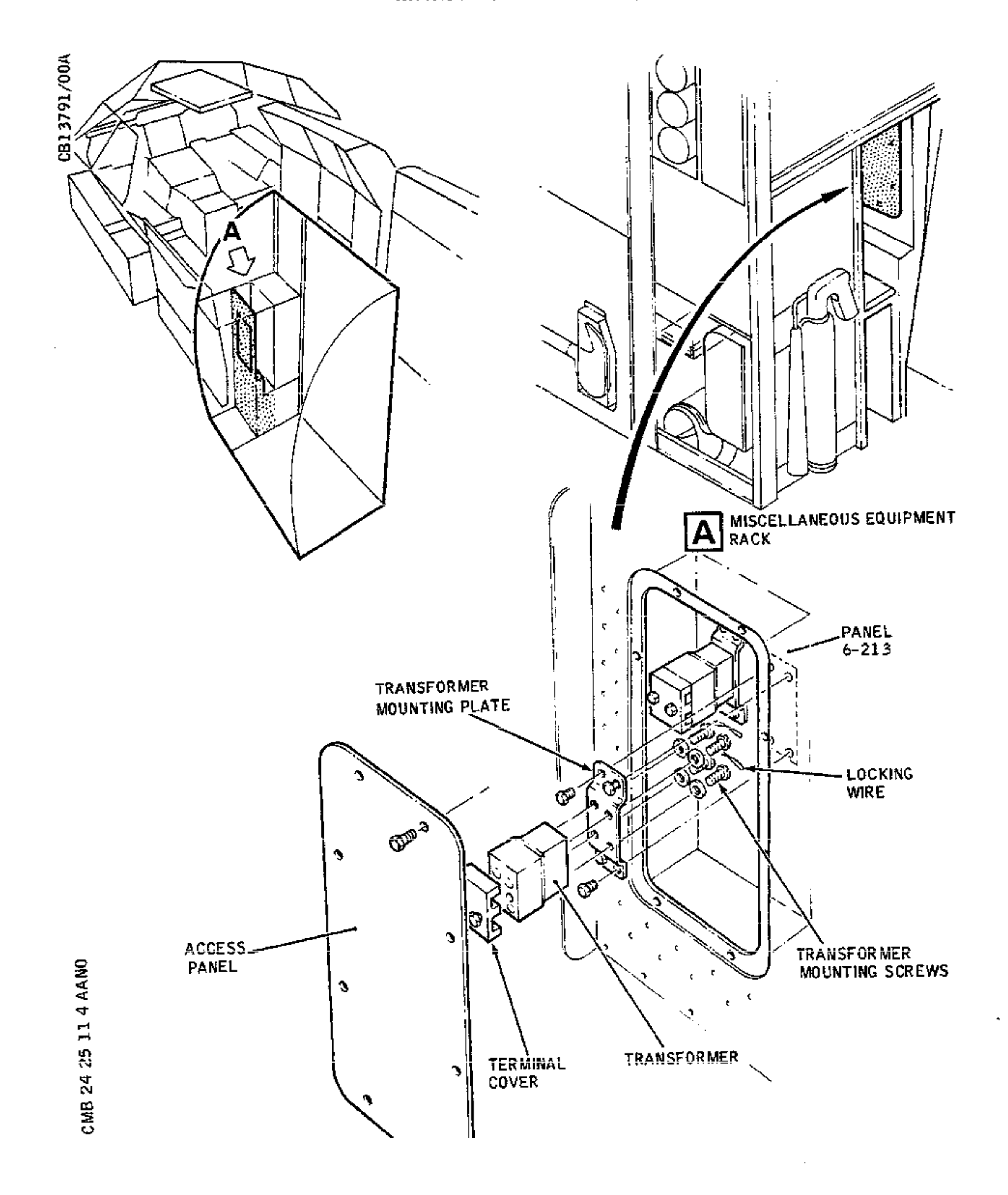
A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 3.5 to 4.0 lbf in (0.040 to 0.045 mdaN)	-
Torque spanner, 14.0 to 16.0 lbf in (0.16 to 0.18 mdaN)	-

B. Prepare

(1) Trip the circuit breakers listed below and fit safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
5 V AC AVIONIC CONSTANT SUP 1	2-213	X550	B18
5 V AC AVIONIC CONSTANT SUP 2	4-213	X551	B14



5 V AC Transformer - Installation
Figure 402

(2) Gain access to the transformer by removing the access panel fitted in the outboard wall of the miscellaneous equipment rack.

C. Remove

(1) Remove the transformer terminal cover and disconnect the cables from the terminals.

(2) Refit the terminal cover.

(3) Remove the screws securing the transformer mounting plate to panel 6-213.

(4) Withdraw the mounting plate and transformer clear of the equipment rack.

(5) Cut the locking wire and remove the screws and washers securing the transformer to the mounting plate.

D. Install

(1) Comply with the electrical safety precautions.

(2) Position the transformer on its mounting plate and secure it with the screws and washers. Wire-lock the screws in accordance with 20-21-13.

(3) Position the mounting plate and transformer on panel 6-213 and secure it with the screws.

(4) Check that the transformer is bonded in accordance with 20-27-11.

(5) Remove the terminal cover from the transformer.

(6) Connect the electrical cables to the transformer terminals, ensuring that the connections are made
R in accordance with the cable identifications and the applicable wiring diagram.

R (7) Torque-tighten 4 UNC terminals to between 3.5 and 4.0 lbf in (0.040 and 0.045 mdaN) and 8 UNC terminals to between 14.0 and 16.0 lbf in (0.16 and 0.18 mdaN).

(8) Refit the terminal cover.

E. Conclusion

(1) Refit the access panel to the outboard wall of the equipment rack.

(2) Remove the safety clips and reset the circuit breakers tripped before removal.

(3) Make available electrical ground power as detailed in 24-41-00.

R (4) Ensure that the 5 V a.c. output is available, by carrying out the appropriate test of the associated system.

(5) Switch off and disconnect electrical ground power.

DC GENERATION - DESCRIPTION AND OPERATION

R **ON A/C 007-007,

1. General (Ref. Fig. 001)

Power supplies for the 28 V d.c. distribution system are provided by four transformer rectifier units (Nos.1, 2, 3 and 4 TRUs). DC essential loads can also be supplied from two batteries.

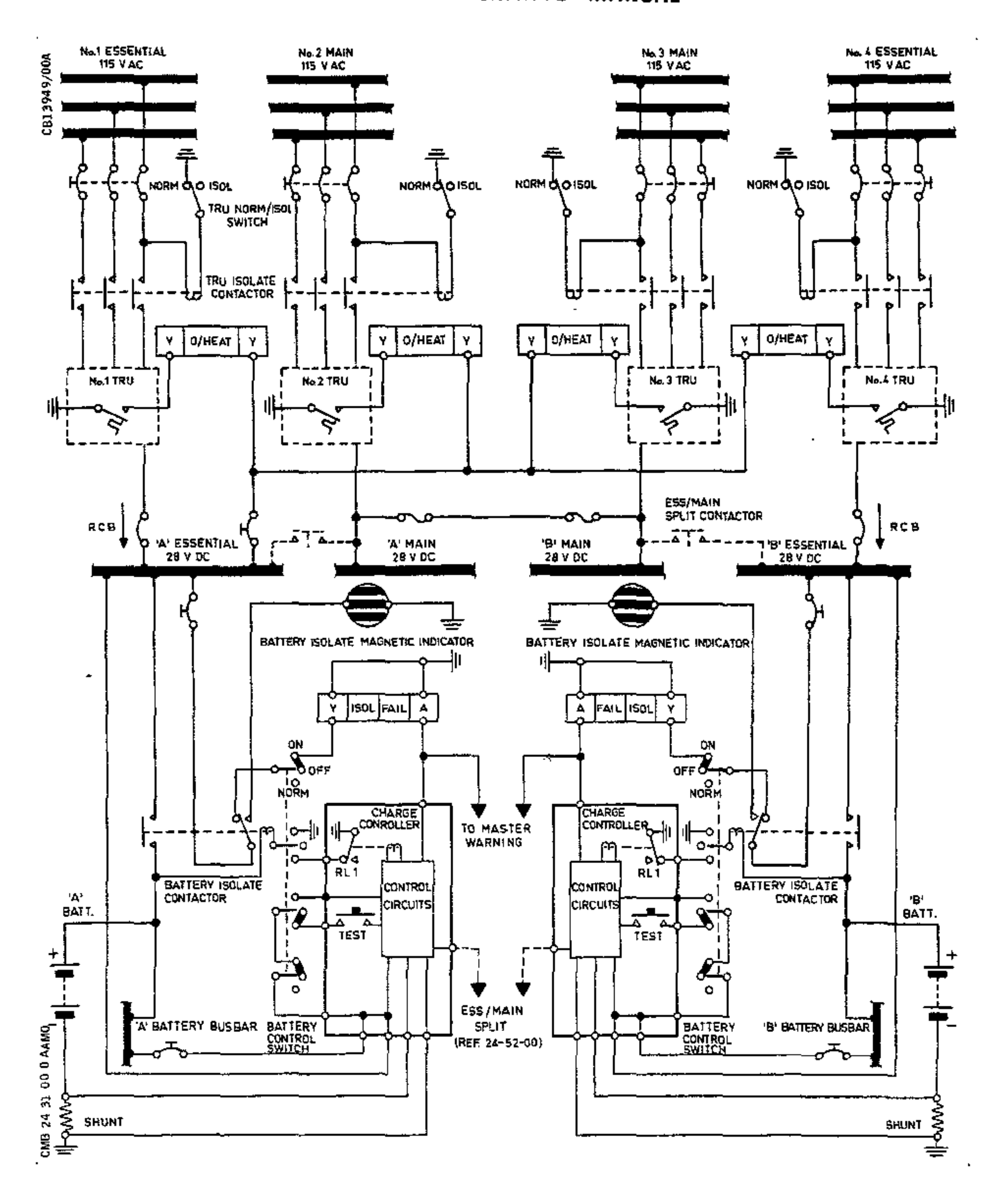
DC generation by the TRUs is automatic whenever a.c. power is available at the 200/115 V a.c. distribution busbars. Nos.1 and 4 TRUs are supplied from similarly numbered essential a.c. busbars and Nos.2 and 3 TRUs from similarly numbered main a.c. busbars, each supply being fed through an associated TRU isolate contactor. TRU normal/isolate switches, one associated with each contactor, provide manual control to permit isolation of a TRU from its power source.

Nos.2 and 3 TRUs supply 'A' and 'B' parts of a main d.c. busbar respectively, the two parts being interconnected by fuse links; Nos.1 and 4 TRUs supply 'A' essential and 'B' essential busbars respectively. The essential busbars are each connected to the main d.c. busbar by an associated essential/main split contactor. Thus, the four TRUs normally operate in parallel.

Added protection for the two essential d.c. busbars is provided by reverse current breakers (RCBs), one interposed in the output feeder of No.1 TRU and the other in the output feeder of No.4 TRU.

Each battery is connected direct to its own battery busbar and, through a battery isolate contactor, to the associated 'A' or 'B' essential busbar. The operation of each contactor is primarily controlled by a battery control switch which, in addition, also controls a battery charge controller. The open or closed condition of each contactor is shown by a 'cross-line' or 'in-line' presentation on an associated magnetic indicator.

An O/HEAT caption, one for each TRU, is illuminated in the event of an associated TRU overheat. The ISOL section of a BATT-FAIL/ISOL caption associated with each battery is illuminated when the associated battery is disconnected from the essential d.c. busbar. The FAIL section is illuminated in the event of a rapid increase of the battery charging current (battery runaway), or a charge in excess of 90 min. Whenever the FAIL section is illuminated the master warning is also activated. (Ref. 33-15-00).



- DC Generation, Control and Indication -
Schematic Diagram
Figure 001

The d.c. generation system controls and indicators, including ammeters, one for each battery, and a d.c. voltmeter with associated rotary selector switch, are located at the third crew member's station. A test socket (DC BUS BAR VOLT), on panel 18-216 in the flight compartment right-hand racking, is connected across the terminals of the d.c. voltmeter to enable it to be checked against a meter of known accuracy.

R **ON A/C 001-006,

1. General (Ref. Fig. 002)

Power supplies for the 28 V d.c. distribution system are provided by four transformer rectifier units (Nos.1, 2, 3 and 4 TRUs). DC essential loads can also be supplied from two batteries.

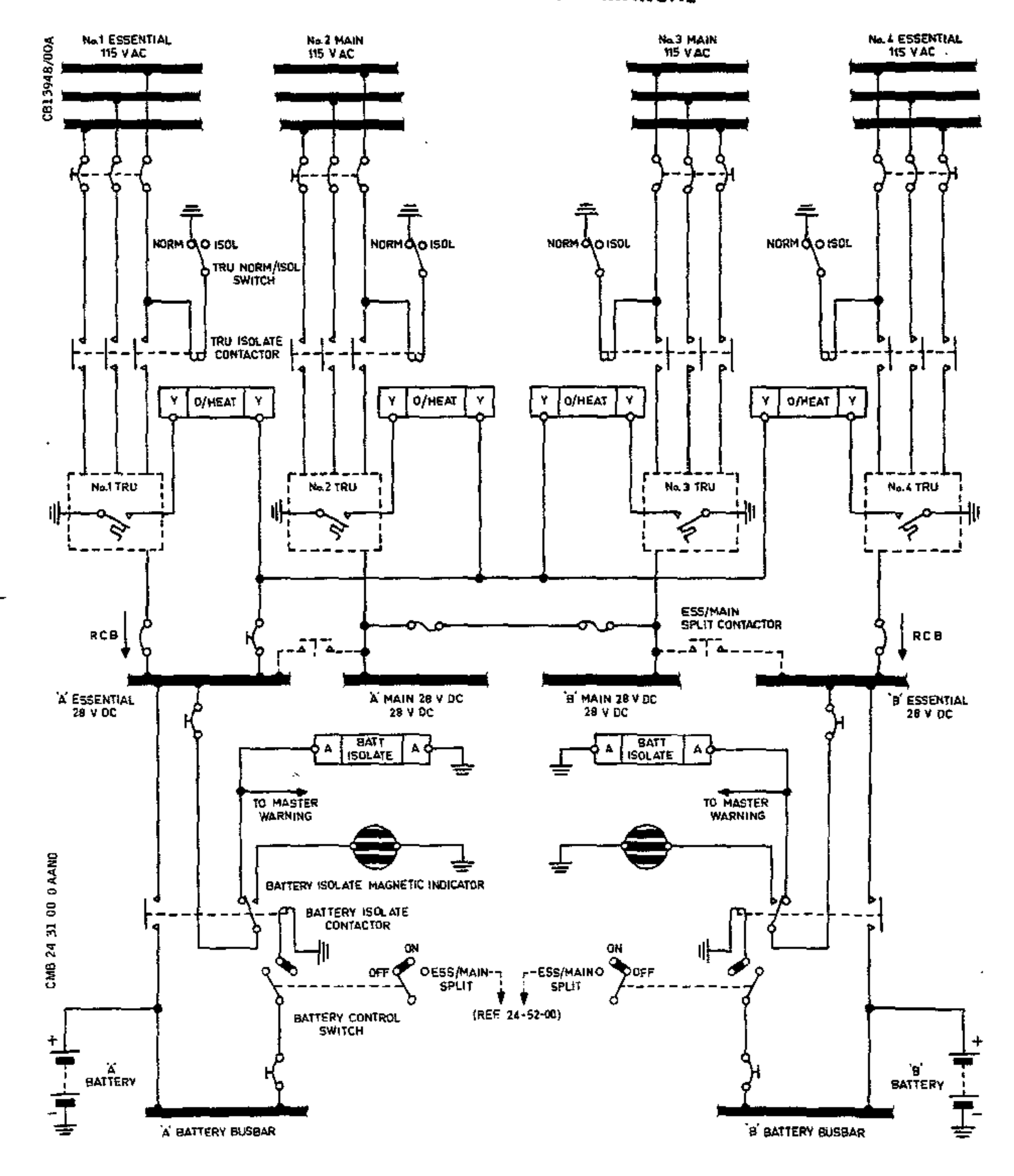
DC generation by the TRUs is automatic whenever a.c. power is available at the 200/115 V a.c. distribution busbars. Nos.1 and 4 TRUs are supplied from similarly numbered essential a.c. busbars and Nos.2 and 3 TRUs from similarly numbered main a.c. busbars, each supply being fed through an associated TRU isolate contactor. TRU normal/isolate switches, one associated with each contactor, provide manual control to permit isolation of a TRU from its power source.

Nos.2 and 3 TRUs supply 'A' and 'B' parts of a main d.c. busbar respectively, the two parts being interconnected by fuse links; Nos.1 and 4 TRUs supply 'A' essential and 'B' essential busbars respectively. The essential busbars are each connected to the main d.c. busbar by an associated essential/main split contactor. Thus, the four TRUs normally operate in parallel.

Added protection for the two essential d.c. busbars is provided by reverse current breakers (RCBs), one interposed in the output feeder of No.1 TRU and the other in the output feeder of No.4 TRU.

Each battery is connected direct to its own battery busbar and, through a battery isolate contactor, to the associated 'A' or 'B' essential busbar. The operation of each contactor is controlled by a battery control switch, the open or closed condition being shown by a cross-line' or 'in-line' presentation on an associated magnetic indicator.

An O/HEAT caption, one for each TRU, is illuminated in the event of an associated TRU overheat. A BATT ISOLATE caption, one for each battery, is illuminated when the associated battery is disconnected from the essential



- DC Generation, Control and Indication -
Schematic Diagram
Figure 002

d.c. busbar. The signal operating the BATT ISOLATE caption is also fed to the master warning system (Ref. 33-15-00).

The d.c. generation system controls and indicators, including ammeters, one for each battery, and a d.c. voltmeter with associated rotary selector switch, are located at the third crew member's station. A test socket (DC BUS BAR VOLT), on panel 18-216 in the flight compartment right-hand racking, is connected across the terminals of the d.c. voltmeter to enable it to be checked against a meter of known accuracy.

R **ON A/C 007-007,

2. <u>Transformer Rectifier Units (TRUs)</u> (Ref. Fig. 003)

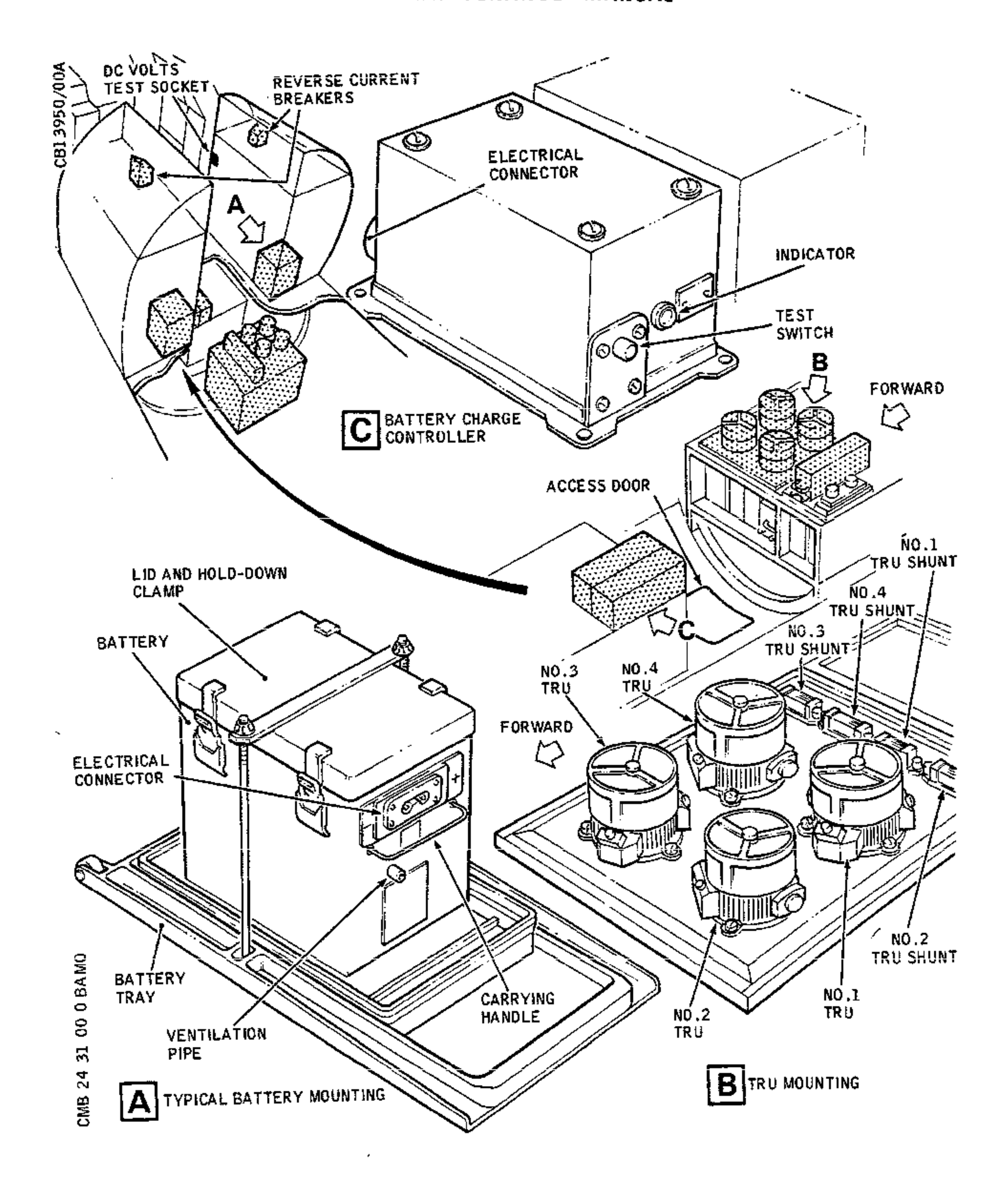
R **ON A/C 001-006,

2. <u>Transformer Rectifier Units (TRUs)</u> (Ref. Fig. 004)

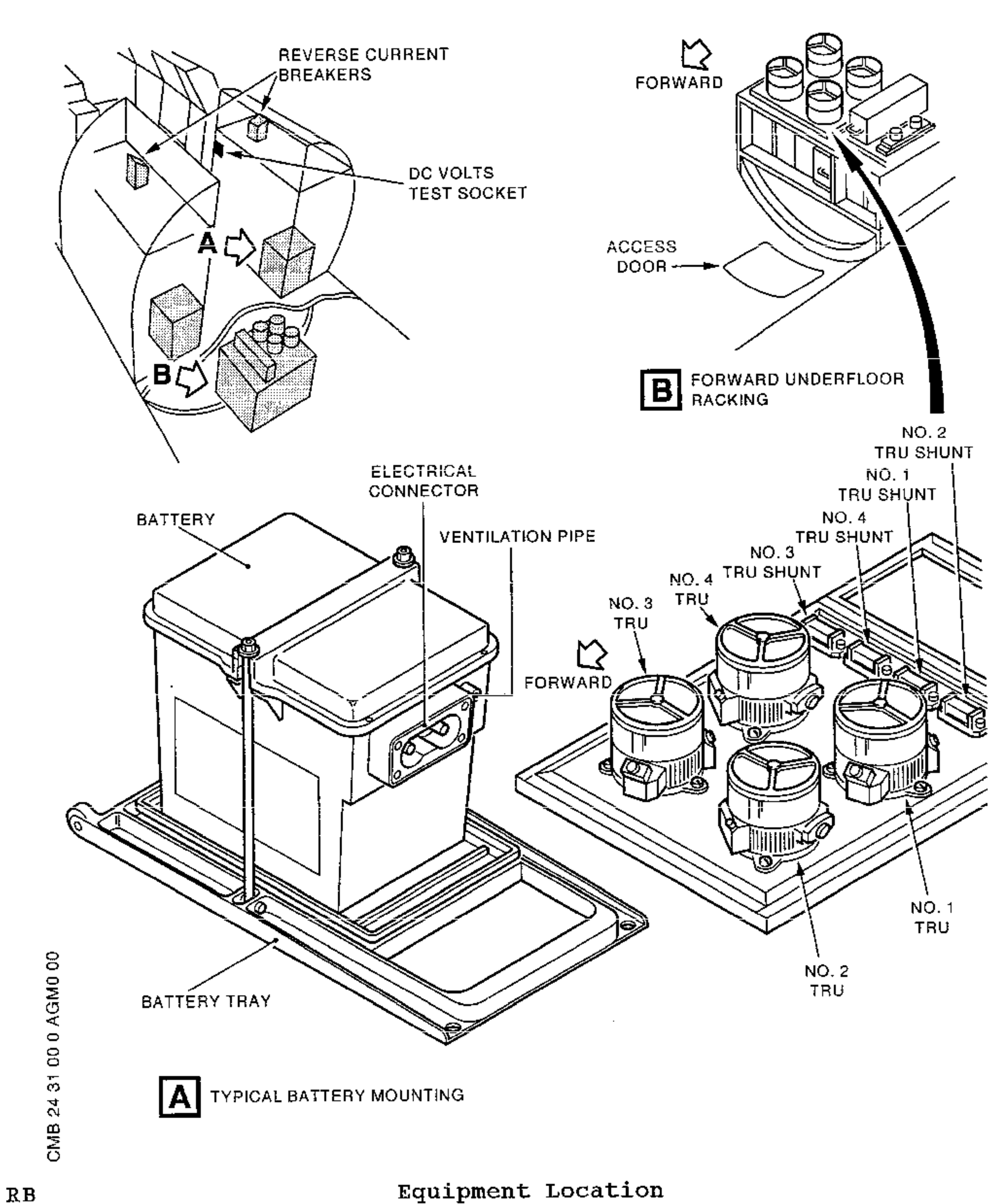
The four TRUs, together with associated ammeter shunts, are housed in the forward underfloor racking on panel 4-123. Each TRU is rated at 150 A and provides an output of approximately 28 V d.c. when connected to a 200/115 V three-phase a.c. supply. The electrical components of each TRU are housed in an upright cylindrical case around the lower periphery of which are receptacles for the input connections, the output terminals and a voltage link mounted in the spaces between three sets of fins. Each TRU is mounted and secured by bolts through three feet at the base of the unit.

The transformer in each unit has a star-connected primary winding and two secondary windings, one star-wound and the other delta-wound. A three-phase full-wave rectifier, mounted on heat-sinks, is connected across each secondary. The d.c. outputs of these rectifiers are connected in parallel in conjunction with an inter-phase coil which reduces the ripple. Resistors are fitted across the output to limit the output voltage when the TRU operates on 'no load'.

The pre-set voltage adjustment comprises a 'jumper' link which can be inserted into associated sockets to select 'maximum', 'mean' or 'minimum' voltage tappings. The 'mean' tapping is normally selected and provides an output of approximately 28.5 V at 15 A to 27.2 V at 150 A. The position of the link can be checked through an opening in a protective cover.



Equipment Location
Figure 003



RB

Equipment Location
Figure 004

A two-speed fan, fitted in the base of each TRU, cools the transformer and the rectifier heat-sinks by drawing air in at the top of the unit and exhausting it through openings in the base of the unit. The speed of the fan is regulated by a thermostat mounted on one of the heat-sinks. High speed is automatically selected when the temperature of the thermostat exceeds 145 deg C and normal speed is resumed when it falls below 90 deg C.

An overheat warning system is operated by the contacts of a second thermostat mounted on a heat-sink. The thermostat closes the contacts at a temperature of 165 deg C and opens them at 143 deg C.

**On A/C 007-007,

3. Batteries (Ref. Fig. 003)

The two batteries, together with associated ammeter shunts, are mounted in the left-hand and right-hand flight compartment racking on panel 19-215 and 19-216 respectively.

Each battery is a 24 V, unspillable, nickel-cadmium type comprising twenty nickel-cadmium cells housed in a titanium container fitted with two handles. Each cell has a nominal voltage of 1.2 V and is fitted with a safety valve, which vents excessive gases into the container. An air inlet plug containing a non-return valve is fitted at one end of the container; at the other end a threaded outlet nozzle is fitted for coupling to the battery venting system (Ref. 21-23-00) which vents the gases to atmosphere. A combined lid and battery hold-down clamp is fitted with a sealing gasket, and secured to the container by toggle-fasteners. Electrical connections are made at a two-pole connector.

**ON A/C 001-006,

3. Batteries (Ref. Fig. 004)

RB The two batteries, together with ammeter shunts are mounted in
RB the left-hand and right-hand flight compartment racking on
RB panel 19-215 and 19-216 respectively.

RB Each battery is a sealed 24 volt, lead acid, unspillable,
RB valve regulated unit. The unit consists of two 12 volt
RB sealed monoblocks connected in series, enclosed in a polyester
RB bonded glass fibre case which incorporates the battery main
RB terminal connector. A combined lid and hold-down frame fits
RB over the battery case.

RB Gases generated by the battery are vented to atmosphere by the
RB battery venting system.

**ON A/C 007-007,

4. Reverse Current Breakers (RCBs) (Ref. Fig. 003)

**ON A/C 001-006,

4. Reverse Current Breakers (RCBs) (Ref. Fig. 004)

The two RCBs are located in the left-hand and the right-hand flight compartment racking on shelf 12-215 and shelf 12-216 respectively.

Each RCB is a single-pole, single-throw circuit breaker which trips automaticaly with a reverse current of 45 A to 55 A. The breaker is reset by pressing a lever under a rubber boot on top of the unit, but cannot be reset with a reverse current flowing. An electrically operated tripping coil is incorporated in the unit but is not connected in this installation.

The breaker can be tripped manually by pressing the button at the side of the rubber boot enclosing the reset lever.

**ON A/C 007-007,

5. Battery Charge Controllers (Ref. Fig. 003)

The two battery charge controllers are mounted on the weather radar racking structure (30-123) in the underfloor racking above the weather radar equipment. Each controller comprises a current sensing circuit, a voltage sensing circuit and a test circuit housed in a rectangular metal case. Electrical connections are made through a connector at one end of the case. A test switch and indicator (light emitting diode) are fitted at the other end.

The sensing circuits control the operation of the associated 'A' or 'B' battery isolate contactor, automatically connecting the battery to the associated essential d.c. busbar, thus -

(a) charging the battery from the busbar, if the battery voltage is low, or

(b) supplying the busbar from the battery, if the busbar voltage is low.

The battery is isolated from the essential d.c. busbar whenever the battery is fully charged and the essential d.c. busbar voltage is at an acceptable level.

The sensing circuits also control the operation of an external battery failure warning caption to indicate a rapid increase in the battery charging current (battery runaway).

The test switch and indicators are provided to check the correct functioning of the sensing circuits.

6. Operation

A. Control and Indication (Ref. Fig. 005)

**ON A/C 001-006,

6. Operation

A. Control and Indication (Ref. Fig. 006)

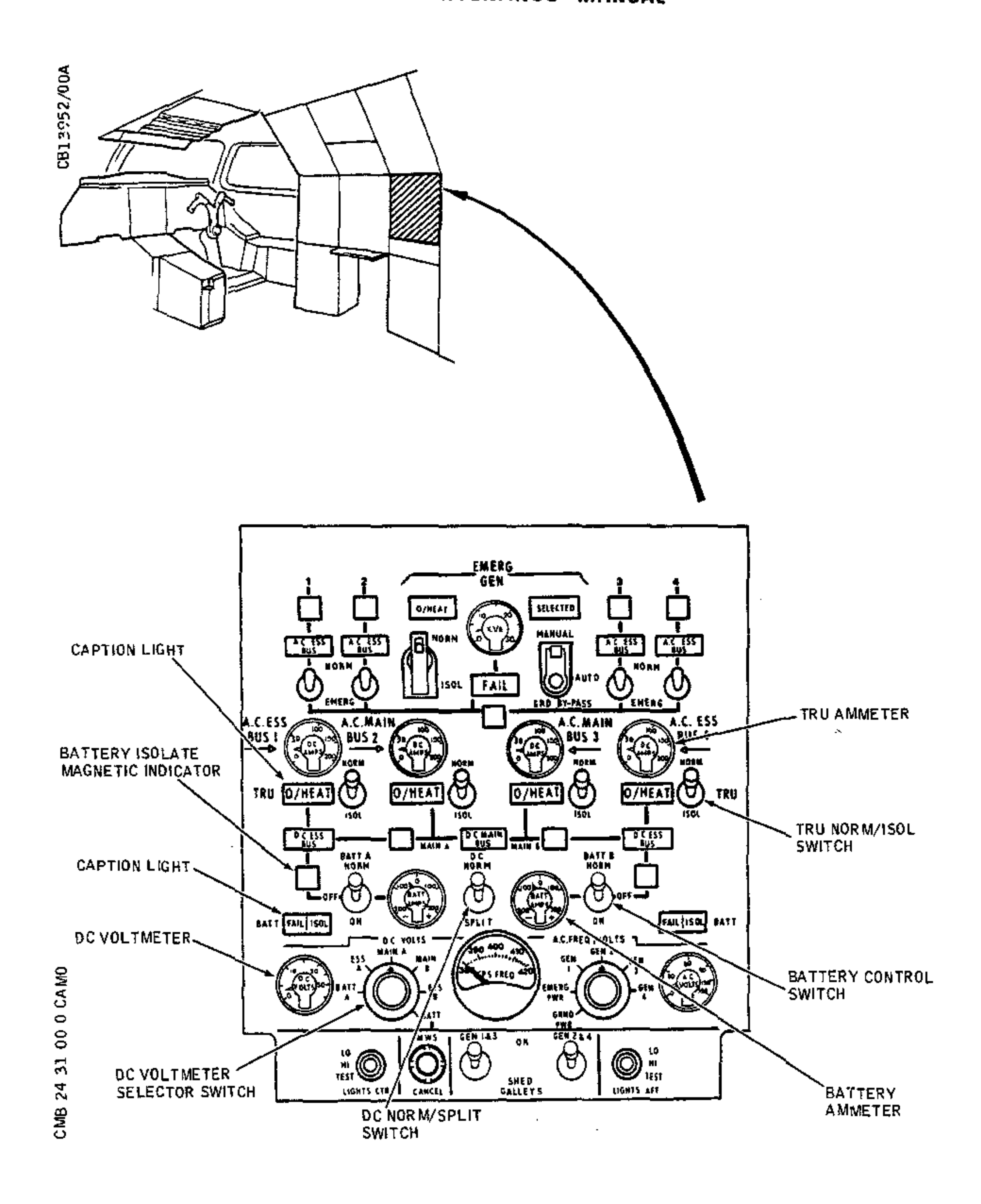
The caption lights, magnetic indicators and control switches, together with the d.c. voltmeter, selector switch and ammeters, are mounted on the lower section of the electrical generating control panel (panel 6-214).

The controls and indicators are positioned with respect to interconnecting lines engraved on the panel to form an operational diagram of the d.c. generating system. The magnetic indicators show 'in-line' or 'cross-line' in relation to the interconnecting lines to denote the 'closed' or 'open' position of the associated battery isolate contactor and thus depict connection/disconnection of the battery to/from the d.c. busbar.

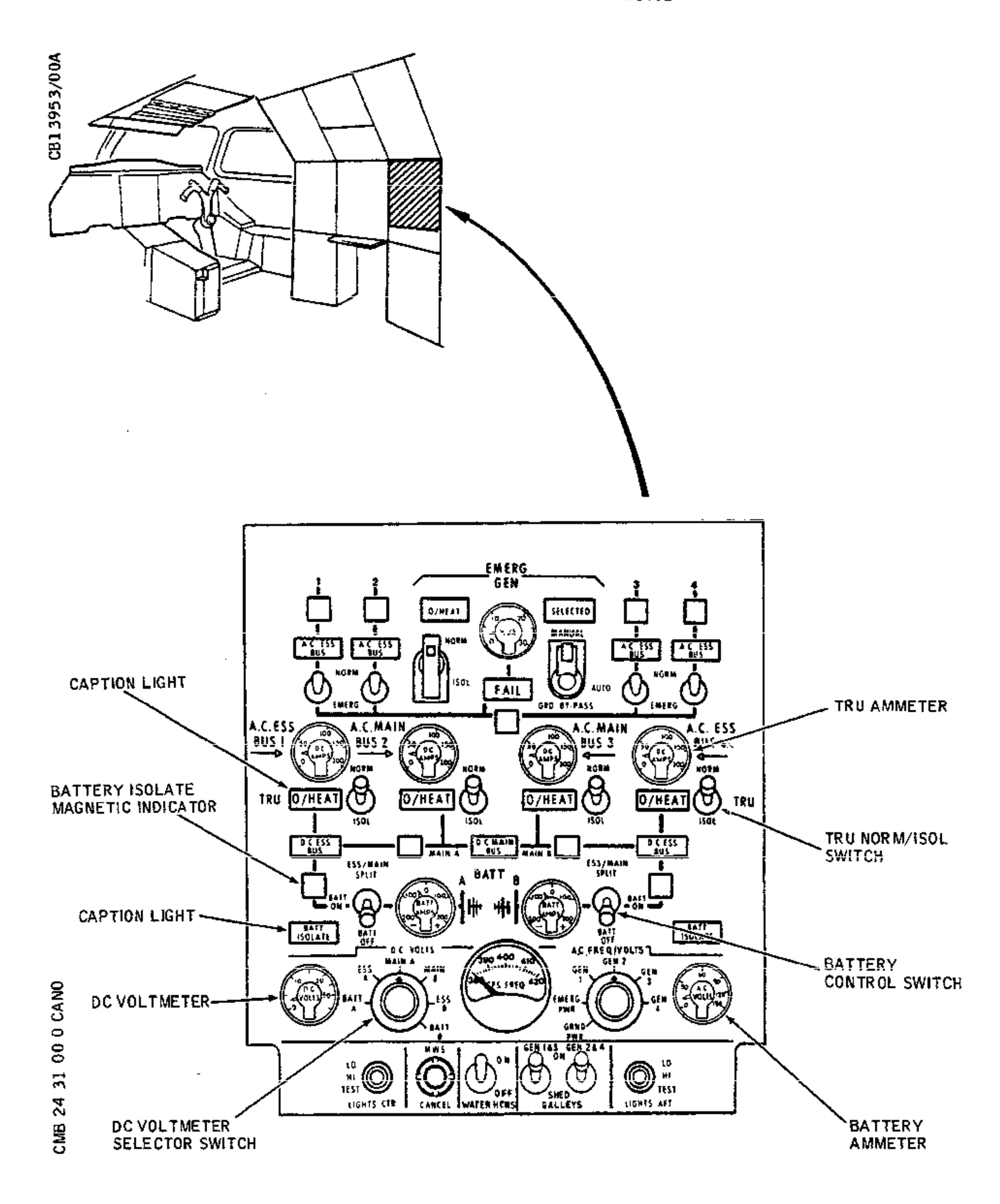
The TRU NORM - ISOL switch for each distribution channel is located below the corresponding channel TRU ammeter. The switches have the positions NORM and ISOL which are effective as follows:

(1) NORM: the a.c. busbar supply is connected to the associated TRU.

(2) ISOL: the a.c. busbar supply is isolated from the associated TRU.



Controls and Indicators
Figure 005



Controls and Indicators
Figure 006

**ON A/C 007-007,

BATT A and BATT B control switches are located below the TRU NORM - ISOL switches. Each switch has the positions ON, OFF and NORM, which are effective as follows:

(1) ON: the battery is connected to the essential d.c. busbar direct, overriding the battery charge controller.

(2) OFF: the battery is disconnected from the essential d.c. busbar.

(3) NORM: battery connection to/from the essential d.c. busbar is determined by the battery charge controller and the illumination of the ISOL section of the BATT - ISOL/FAIL caption is inhibited.

An adjacent DC NORM - SPLIT control switch provides manual control for separation of the main and essential d.c. busbars (Ref. 24-52-00).

The appropriate O/HEAT warning caption is illuminated if the overheat thermostat in the associated TRU is operated. The ISOL section of the BATT - ISOL/FAIL caption is illuminated when the associated battery is disconnected from the essential d.c. busbar except when NORM is selected at the associated battery control switch. The FAIL section of the BATT - FAIL/ISOL warning caption is illuminated if a battery 'runaway' condition is sensed or if the battery charge time exceeds 90 min.

The O/HEAT and BATT - ISOL/FAIL caption light modules incorporate a press-to-test facility; the filaments in these modules can be tested or dimmed by the flight compartment lights test and dimming facility (Ref. 33-14-00).

**ON A/C 001-006,

BATT A and BATT B control switches are located below the TRU NORM - ISOL switches. Each switch has the positions BATT OFF, BATT ON and ESS/MAIN SPLIT which are effective as follows:

(1) BATT OFF: the battery is disconnected from the essential d.c. busbar.

(2) BATT ON: the battery is connected to the essential d.c. busbar.

(3) ESS/MAIN SPLIT: the battery is connected to the essential d.c. busbar and the automatic control circuit of the associated essential/main split contactor is interrupted to separate the main and essential d.c. busbars (Ref. 24-52-00).

The appropriate O/HEAT warning caption is illuminated if the overheat thermostat in the associated TRU is operated. The BATT ISOLATE caption is illuminated when the associated battery is disconnected from the essential d.c. busbar.

The O/HEAT and BATT ISOLATE caption light modules incorporate a press-to-test facility; the filaments in these modules can be tested or dimmed by the flight compartment lights test and dimming facility (Ref. 33-14-00).

The d.c. voltmeter is used to monitor the supply voltage on the main and associated d.c. busbars and the battery busbars by appropriate setting of the associated rotary selector switch.

The ammeter for each TRU is calibrated from 0 to 200 A and indicates TRU d.c. loads. The ammeter for each battery is calibrated from -200 A to +200 A and indicates battery discharge (load) or charge.

**ON A/C 007-007,

B. Functional Description (Ref. Fig. 001)

Under normal operating conditions the TRU NORM - ISOL and the battery control switches are set at NORM. With normal operation of the a.c. distribution system (Ref. 24-51-00) the TRU isolate contactors are closed and the a.c. supplies from the a.c. busbars are applied in parallel to the TRUs. Each TRU functions automatically on reception of a.c. power. Nos.2 and 3 TRUs supply d.c. power direct to the main d.c. busbars, while Nos.1 and 4 TRUs feed d.c. power through the RCBs to the associated essential d.c. busbars. The battery isolate magnetic indicators show 'in-line' and the ISOL sections of the BATT - ISOL/FAIL captions are extinguished.

In the event of a TRU overheat, the internal thermostat operates and the associated O/HEAT caption is illuminated.

**ON A/C 001-006,

B. Functional Description (Ref. Fig. 002)

Under normal operating conditions the TRU NORM - ISOL switches are set at NORM and the battery control switches at BATT ON. With normal operation of the a.c. distribution system (Ref. 24-51-00) the TRU isolate contactors are closed and the a.c. supplies from the a.c. busbars are applied in parallel to the TRUs.

Each TRU functions automatically on reception of a.c. power. Nos.2 and 3 TRUs supply d.c. power direct to the main d.c. busbars, while Nos.1 and 4 TRUs feed d.c. power through the RCBs to the associated essential d.c. busbars. The battery isolate magnetic indicators show 'in-line' and the BATT ISOLATE captions are extinguished.

In the event of a TRU overheat, the internal thermostat operates and the associated O/HEAT caption is illuminated.

Setting the appropriate TRU NORM - ISOL switch to ISOL opens the TRU isolate contactor, thus disconnecting the affected TRU from the a.c. supply source.

In the event of a reverse current of 50 A, approximately, the appropriate RCB trips automatically, thus isolating the associated TRU output from the d.c. essential busbar.

**ON A/C 007-007,

Each battery is automatically connected to the essential d.c. busbar for an initial charge. When the battery charge controller senses a fully charged condition it disconnects the battery from the essential d.c. busbar and monitors the battery and essential d.c. busbar voltages. If either voltage falls to an unacceptable level, the charge controller reconnects the battery to the essential d.c. busbar. The battery FAIL caption is illuminated and the master warning activated (Ref. 33-15-00) if the charge controller senses a rapid current rise during the charge period (battery runaway) or if the charge period exceeds 90 min.

When the charge controller test switch is pressed a signal is initiated which tests the sensing circuits and activates the adjacent light emitting diode if all circuits are functioning correctly.

DC GENERATION - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains instructions for the removal and installation of ammeter shunts associated with 'A' and 'B' system batteries and with Nos.1, 2, 3 and 4 transformer rectifier units (TRUs). The battery and TRU ammeter shunts are identical.

The 'A' system and 'B' system battery ammeter shunts are fitted in the flight compartment LH and RH racking respectively, in the associated battery bays (19-215 and 19-216). The shunt is secured by screws to the sidewall of the battery bay, near the outboard edge, and electrical connections are made to stud terminals fitted with nuts and washers.

To gain access to the shunt, the associated battery must be removed from its bay.

Each TRU ammeter shunt is mounted in the forward underfloor racking on panel 4-123, aft of the TRUs. To gain access to the shunt, two or more TRUs must be removed from the panel.

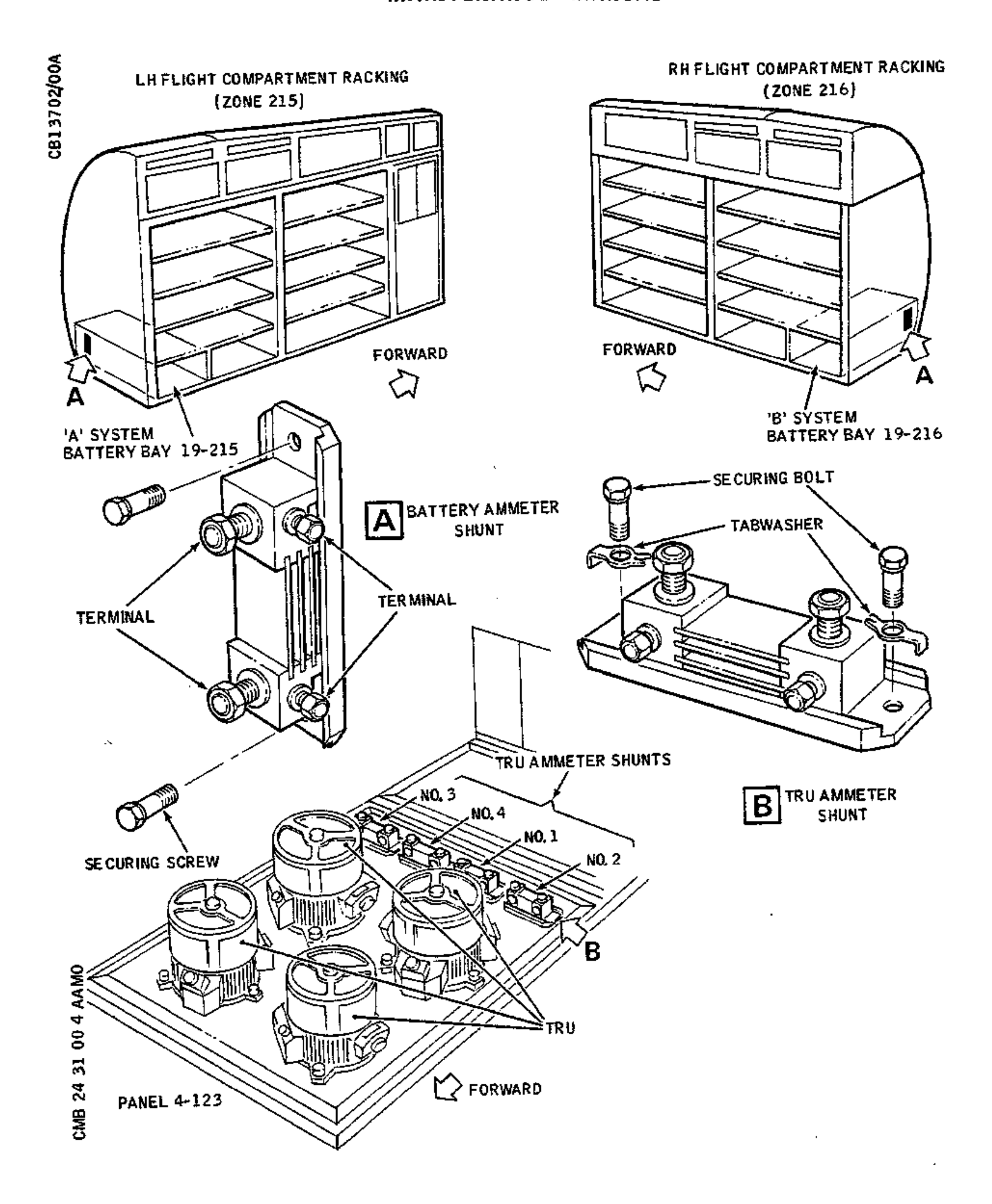
Instructions for the removal and installation of other minor electrical components associated with d.c. generation, comprising ammeters, caption light modules, magnetic indicators and switches, mounted on the lower electrical management panel (6-214), and contactors mounted in the flight compartment LH and RH racking on shelves 12-215 and 12-216, are contained in 24-00-00.

2. Battery Ammeter Shunt (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 180 to 200 lbf in (2.04 tO 2.20 mdaN)	-
Torque spanner, 8 to 9 lbf in (0.090 to 0.102 mdaN)	-

Printed in England



Battery Ammeter Shunt - Installation
Figure 401

B. Prepare

(1) Ensure that BATT A and BATT B control switches are at OFF.

(2) Remove the appropriate sealing panel from the flight compartment LH or RH racking, as applicable (Ref. 25-71-00), to uncover 'A' or 'B' system battery bay, respectively.

(3) Remove the battery as detailed in 24-31-11 to gain access to the battery ammeter shunt on the sidewall of the battery bay.

C. Remove

(1) Disconnect the electrical cables from the shunt terminals.

(2) Remove the screws securing the shunt to the side-wall and withdraw the shunt from the battery bay.

D. Install

(1) Comply with the electrical safety precautions.

(2) Orientate the shunt so that the small stud terminals on the side of the shunt are facing inboard. Support the shunt on the sidewall of the battery bay and secure it to its mounting with the screws.

(3) Connect the electrical cables to the shunt terminals with nuts and washers, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the large terminal nuts to between 180 and 200 lbf in (2.04 and 2.20 mdaN). Torque-tighten the small terminal nuts to between 8 and 9 lbf in (0.090 and 0.102 mdaN).

E. Conclusion

(1) Install the battery as detailed in 24-31-11.

(2) Cancel the electrical safety precautions taken before removal, and check the operation of the shunt by carrying out the appropriate test procedure.

(3) Install the flight compartment racking sealing as detailed in 25-71-00.

3. TRU Ammeter Shunt (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 180 to 200 lbf in (2.04 to 2.20 mdaN)	-
Torque spanner, 8 to 9 lbf in (0.090 to 0.102 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Open service compartment door 123 AB (Ref. 52-41-11) to gain access to the forward underfloor racking.

(3) Remove the appropriate TRUs as detailed in 24-31-12 to gain access to the TRU ammeter shunt on panel 4-123, aft of the TRUs.

C. Remove

(1) Disconnect the electrical cables from the shunt terminals.

(2) Remove the bolts and tabwashers securing the shunt to its mounting and withdraw the shunt from the panel.

D. Install

(1) Comply with the electrical safety precautions.

(2) Position the TRU ammeter shunt on its mounting, ensuring that it is orientated as follows: No.1 or No.3 shunt, the small stud terminals on the side of the shunt facing aft; No.2 or No.4 shunt, the small stud terminal facing forward. Secure the shunt to its mounting with the bolts and tabwashers.

(3) Connect the electrical cables to the shunt terminals with the nuts and washers, ensuring that the connections are made in accordance with

the cable identifications and the applicable wiring diagram. Torque-tighten the large terminal nuts to between 180 and 200 lbf in (2.04 and 2.20 mdaN). Torque-tighten the small terminal nuts to between 8 and 9 lbf in (0.090 and 0.102 mdaN).

E. Conclusion

(1) Install the TRUs as detailed in 24-31-12.

(2) Cancel the electrical safety precautions taken before removal, and check the operation of the shunt by carrying out the appropriate test procedure.

(3) Close and secure service compartment door 123 AB (Ref. 52-41-11).

R **ON A/C 007-007,

DC GENERATION - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains the DC Generation System Test, which is a comprehensive test carried out at major maintenance periods of the aircraft. Operational and Functional Tests are not included since the checks of the DC Generation System that are required under each of these headings are incorporated in the Operational Test and Functional Test given under the General section (Ref. 24-00-00, Adjustment/Test).

The tests applicable to the associated battery venting system are separately contained in Chapter 21 (Ref. 21-23-00, Adjustment/Test).

For convenience of application, the System Test is divided into a series of tests identified under separate sub-headings as follows:-

Test - Preliminary (Control and Indication Circuits)

Test - TRU (Transformer Rectifier Units) Overheat Warning Circuits

Test - TRU Operation and Load Distribution

Test - DC Essential/Main Split - AC Undervolt Control

Test - Battery Charge Control

At the conclusion of individual tests certain operations, e.g., cancelling electrical isolation precautions or switching off electrical ground power, may be omitted, provided that a sequential test validates the omission.

2. System Test

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

WHEN EITHER BATTERY CONTROL SWITCH IS SET TO "ON" OR "NORM" IN THE ABSENCE OF AIRCRAFT-GENERATED OR EXTERNAL POWER SUPPLIES, THE SELECTED BATTERY ALONE SUPPLIES ALL LOADS STANDING ON THE ASSOCIATED ESSENTIAL D.C. BUSBAR. THE BATTERY CONTROL SWITCHES SHOULD THEREFORE BE SET TO "ON" OR "NORM" ONLY FOR THE MINIMUM PERIOD REQUIRED TO COMPLETE ANY TEST OPERATION APPLICABLE BEFORE EXTERNAL POWER IS CONNECTED TO THE SYSTEM.

ILLUMINATION OF THE "FAIL" SECTION OF A "BATT - FAIL/ ISOL", CAPTION INDICATES A 'RUNAWAY' CONDITION OF THE ASSOCIATED BATTERY. THIS INDICATION REQUIRES IMMEDIATE ACTION TO INVESTIGATE THE CAUSE.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Precision-grade d.c. voltmeter calibrated to provide accurate readings in the range of 0 to 30 V d.c., required for Preliminary Test	-
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN), required for DC Essential/Main Split - AC Undervolt Control Test	-

B. Test - Preliminary (Control and Indication Circuits)

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) On the electrical generating control panel, check that -

c1) BATT A and BATT B control switches are both

at OFF, and the DC VOLTS selector switch is at BATT A,

c2) the DC NORM/SPLIT switch is at NORM,

c3) the emergency generator control switch is at AUTO,

c4) all captions are extinguished,

c5) all magnetic indicators display cross-line,

c6) the four TRU ammeters indicate zero,

c7) the DC VOLTS meter indicates 24 V approx., and

c8) the BATT A and BATT B ammeters both indicate zero.

(d) Trip the BAT A V/METER SUP circuit breaker D124 on panel 16-215, and fit a safety clip.

(e) Trip the BAT B V/METER SUP circuit breaker D125 on panel 16-216, and fit a safety clip.

(f) Connect the precision-grade d.c. voltmeter to pins A (+ve) and B (-ve) of the d.c. test socket D128-A on panel 18-216.

(2) Test

(a) Remove the safety clip and reset the circuit breaker tripped in operation (1)(d). Check that -

a1) the voltage of battery A is indicated on the d.c. test voltmeter connected at the d.c. test socket, and

a2) the voltage indication given on the aircraft DC VOLTS meter is consistent with the indication given on the test voltmeter.

NOTE: With a fully charged battery installed the d.c. voltage indicated on the test voltmeter should not be less than 24 V.

The calibration tolerance for the aircraft DC VOLTS meter is ±2.5 per cent of the full scale deflection.

(b) Set the DC VOLTS selector switch to "BATT B" and check that the indications given on the d.c. test voltmeter and the aircraft DC VOLTS meter fall to zero.

(c) Remove the safety clip and reset the circuit breaker tripped in operation (1)(e). Check that -

c1) the voltage of battery B is indicated on the d.c. test voltmeter connected at the test socket, and

c2) the voltage indication given on the aircraft DC VOLTS meter is consistent with the indication given on the test voltmeter.

NOTE: With a fully charged battery installed, the d.c. voltage indicated on the test voltmeter should not be less than 24 V.

(d) Set the DC VOLTS selector switch to "ESS A" and check that the indications given on the d.c. test voltmeter and the aircraft DC VOLTS meter fall to zero.

(e) Set BATT A control switch to "ON". Check that battery A is connected to the 'A' system essential d.c. busbar by observing that -

e1) the 'A' system 'battery isolate' magnetic indicator changes from cross-line to in-line,

e2) both essential/main split magnetic indicators remain cross-line,

e3) the ISOL and FAIL sections of both 'A' and 'B' system BATT-FAIL/ISOL captions and the 'A' system DC ESS BUS caption remain extinguished,

e4) the 'B' system DC ESS BUS caption and the DC MAIN BUS caption are illuminated,

e5) battery A voltage is indicated on the D.C. VOLTS meter,

e6) the BATT A ammeter indicates a load (discharge) current reflecting the aircraft

loads standing on the 'A' system d.c. essential busbar, and

e7) the captions CSD 1, CSD 2, GEN 1, GEN 2, No.1 AC MAIN BUS, No.2 AC MAIN BUS, No.1 AC ESS BUS and No.2 AC ESS BUS are illuminated.

(f) Set BATT A control switch to "NORM" and check that the indications required at e1) to e7), inclusive, under operation (e) remain unchanged.

(g) Set the DC VOLTS selector switch to "ESS B" and check that the indications given on the DC VOLTS meter fall to zero.

(h) Set BATT A control switch to "OFF". Check that battery A is disconnected from the 'A' system d.c. essential busbar by observing that -

h1) the 'A' system 'battery isolate' magnetic indicator changes from in-line to cross-line,

h2) the ISOL and FAIL sections of both 'A' and 'B' systems BATT - FAIL/ISOL captions and the 'A' system DC ESS BUS caption remain extinguished,

h3) the 'B' system DC ESS BUS caption and the DC MAIN BUS caption are extinguished,

h4) the load (discharge) current indication on BATT A ammeter falls to zero, and

h5) the captions CSD 1, CSD 2, GEN 1, GEN 2, No.1 AC MAIN BUS, No.2 AC MAIN BUS, No.1 AC ESS BUS and No.2 AC ESS BUS are extinguished.

(i) Set BATT B control switch to "ON". Check that battery B is connected to the 'B' system essential d.c. busbar by observing that -

i1) the 'B' system 'battery isolate' magnetic indicator changes from cross-line to in-line,

i2) both essential/main split magnetic indicators remain cross-line,

i3) the ISOL and FAIL sections of both 'A' and 'B' systems BATT - FAIL/ISOL captions, the 'B' system DC ESS BUS caption and the DC MAIN BUS caption remain extinguished,

i4) the 'A' system DC ESS BUS caption is illuminated,

i5) battery B voltage is indicated on the DC VOLTS meter,

i6) the BATT B ammeter indicates a load (discharge) current reflecting the loads standing on the 'B' system d.c. essential busbar, and

i7) the captions CSD 3, CSD 4, GEN 3, GEN 4, No.3 AC MAIN BUS, No.4 AC MAIN BUS, No.3 AC ESS BUS and No.4 AC ESS BUS are illuminated.

(j) Set BATT B control switch to "NORM" and check that the indications required at i1) to i7), inclusive, under operation (i) remain unchanged.

(k) Set the DC VOLTS selector switch to "MAIN A" and check that the indications on the DC VOLTS meter fall to zero.

(l) Set BATT B control switch to "OFF".
Check that battery B is disconnected from the 'B' system d.c. essential busbar by observing that -

l1) the 'B' system 'battery isolate' magnetic indicator changes from in-line to cross-line,

l2) the ISOL and FAIL sections of both 'A' and 'B' systems BATT - FAIL/ISOL captions, the 'B' system DC ESS BUS caption and the DC MAIN BUS caption remain extinguished.

l3) the 'A' system DC ESS BUS caption is extinguished,

l4) the load (discharge) current indication on BATT B ammeter falls to zero, and

l5) the captions CSD 3, CSD 4, GEN 3, GEN 4, No.3 AC MAIN BUS, No.4 AC MAIN BUS, No.3 AC ESS BUS and No.4 AC ESS BUS are

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extinguished.

(3) Conclusion

(a) Disconnect and remove the precision-grade voltmeter from the d.c. test socket D128-A on panel 18-216.

(b) Cancel the electrical isolation precautions taken in operation (1)(a), not already superseded by subsequent operations, i.e., remove the warning notices.

C. Test - TRU (Transformer Rectifier Units) Overheat Warning Circuits

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) Trip the following circuit breakers. Fit safety clips to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
TRU O/HEAT IND	1-213	P7	N8
NO. 1 TRU SUP	2-213	1P1	B20
NO. 4 TRU SUP	4-213	4P1	F14
NO. 2 TRU SUP	21-215	2P1	-
NO. 3 TRU SUP	21-216	3P1	-

(d) Open the forward underfloor service compartment door 123 AB (Ref. 52-41-11) to permit access to Nos.1, 2, 3 and 4 TRUs on panel 4-123 in the forward underfloor racking.

(e) Disconnect the input electrical connector from

each TRU. Using a suitable cable link, connect pin 4 of each 'free' connector (1P4-A, 2P4-A, 3P4-A and 4P4-A) to a convenient earth point.

(2) Test

(a) Remove the safety clip and reset the TRU O/HEAT IND circuit breaker P7 on panel 1-213, map ref.N8

(b) Set BATT A control switch to "ON". Ignoring all other indications on the electrical generating control panel, check that -

b1) the 'A' system 'battery isolate' magnetic indicator changes from cross-line to in-line and

b2) Nos.1, 2, 3 and 4 TRU O/HEAT captions are illuminated.

(c) Set BATT A control switch to "OFF". Check that -

c1) the 'A' system 'battery isolate' magnetic indicator changes from in-line to cross-line, and

c2) Nos.1, 2, 3 and 4 TRU O/HEAT captions are extinguished.

(3) Conclusion

(a) Trip the TRU O/HEAT IND circuit breaker P7 on panel 1-213, map ref.N8, and fit a safety clip.

(b) Remove the cable links connecting pin 4 to earth at each TRU input 'free' connector (1P4-A, 2P4-A, 3P4-A and 4P4-A) and reconnect each connector to the associated TRU, ensuring that the mating surfaces are clean and undamaged.

(c) Remove the safety clips and reset all the circuit breakers listed in paragraph (1)(c).

(d) Cancel the electrical isolation precautions taken in operation (1)(a), not already superseded by subsequent operations, i.e., remove the warning notices.

(e) Close and secure the forward underfloor service

compartment door 123 AB (Ref. 52-41-11).

(f) Make available electrical ground power as detailed in 24-41-00. Check that the total d.c. load is shared by Nos.1, 2, 3 and 4 TRUs as indicated on the associated ammeters.

(g) Switch off and disconnect electrical ground power as detailed in 24-41-00.

D. Test - TRU Operation and Load Distribution

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) Gain access to No.1 TRU reverse current circuit breaker (RCB) 1P18, on shelf 12-215, by opening the appropriate circuit breaker panel. Trip the RCB by depressing the mechanical trip button at the side of the rubber boot enclosing the mechanical reset lever on top of the unit. Close and secure the circuit breaker panel.

(d) Gain access to No.4 TRU RCB, 2P18 on shelf 12-216, by opening the appropriate circuit breaker panel. Trip the RCB by depressing the mechanical trip button at the side of the rubber boot enclosing the mechanical reset lever on top of the unit. Close and secure the circuit breaker panel.

(e) Open the forward underfloor service compartment door 123 AB (Ref. 52-41-11) to permit access to Nos.1, 2, 3 and 4 TRUs on panel 4-123 in the forward underfloor racking.

(2) Test

(a) Make available electrical ground power as detailed in 24-41-00.

(b) On the electrical generating control panel, ensure that -

b1) BATT A and BATT B control switches are at

OFF, the associated 'battery isolate' magnetic indicators display cross-line, the DC NORM/SPLIT control switch is at NORM, and the essential/main split magnetic indicators display in-line,

b2) all four TRU control switches are at NORM, and

b3) only the captions GRND PWR AVAILABLE, CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and the ISOL sections of both 'A' and 'B' system BATT - FAIL/ISOL captions are illuminated.

(c) Check at No.1, No.2, No.3 and No.4 TRUs that the cooling fan in each TRU is working.

NOTE: There is no visual indication of TRU fan operation, but it is practicable to check that the fan is working by using the hand to sense the expulsion of ventilating air from the openings in the lower periphery of the TRU.

(d) Select and switch on aircraft d.c. loads up to but not exceeding 120 A, checking that -

d1) the total d.c. load is shared by Nos.2 and 3 TRUs, as indicated on the associated ammeters, and

d2) the readings on both Nos.1 and 4 TRU ammeters are zero.

(e) Set the DC VOLTS selector switch to "ESS A", then in turn to "MAIN A", "MAIN B" and "ESS B", checking at each switch position that approximately 28 V is indicated on the DC VOLTS meter, i.e., nominal d.c. voltage.

(f) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(g) Gain access to No.1 TRU RCB, 1P18 on shelf 12-215, by opening the appropriate circuit breaker panel. Reset the RCB by depressing the mechanical reset lever enclosed in the rubber boot at the top of the unit.

Close and secure the circuit breaker panel.

(h) Gain access to No.4 TRU RCB, 2P18 on shelf 12-216, by opening the appropriate circuit breaker panel. Reset the RCB by depressing the mechanical reset lever enclosed in the rubber boot at the top of the unit. Close and secure the circuit breaker panel.

(i) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Check that -

i1) the total d.c. load is supplied by Nos.1, 2, 3 and 4 TRUs, as indicated on the associated ammeters,

i2) both 'A' and 'B' system essential/main split magnetic indicators display in-line, and

i3) approximately 28 V is indicated on the DC VOLTS meter, i.e., nominal d.c. voltage.

(j) Set BATT A and BATT B control switches to "ON". Check that the ISOL and FAIL sections of both 'A' and 'B' system BATT - FAIL/ISOL captions are extinguished.

(k) Set the DC VOLTS selector switch to "MAIN A", then set each TRU control switch, in turn, to "ISOL" and check that each TRU ammeter reading falls to zero as the associated ISOL selection is made. When all four TRUs are isolated, check that -

k1) the readings on the DC VOLTS meter fall to zero,

k2) both 'A' and 'B' system essential/main split magnetic indicators change from in-line to cross-line, and

k3) the DC MAIN BUS caption is illuminated.

NOTE: Isolation of the d.c. main busbar is initiated by undervolt detectors that have an inverse time delay and, normally, d.c. main busbar isolation will occur between 2 and 10 s after the last TRU is switched off.

(l) Return all four TRU control switches to "NORM". Check that -

(1) both 'A' and 'B' system essential/main split magnetic indicators change from cross-line to in-line,

(2) the DC MAIN BUS caption is extinguished, and

(3) the DC VOLTS meter registers the nominal d.c. voltage.

(m) Set BATT A control switch to "NORM" and then back to "ON", checking that the 'A' system 'battery isolate' magnetic indicator remains in-line.

(n) Set BATT B control switch to "NORM" and then back to "ON", checking that the 'B' system 'battery isolate' magnetic indicator remains in-line.

(o) Set BATT A and BATT B control switches to "OFF". Check that the associated magnetic indicators change from in-line to cross-line.

(p) Set the DC NORM/SPLIT control switch to "SPLIT" and check that both 'A' and 'B' system essential/main split magnetic indicators change from in-line to cross-line.

(q) Return the DC NORM/SPLIT control switch to "NORM" and check that both 'A' and 'B' system essential/main split magnetic indicators change from cross-line to in-line.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

(b) Cancel the electrical isolation precautions taken in operation (1)(a), not already superseded by subsequent operations, i.e., remove the warning notices.

(c) Close and secure the forward underfloor service compartment door 123 AB (Ref. 52-41-11).

E. Test - DC Essential/Main Split - AC Undervolt Control

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) Gain access to No.3 main a.c. undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover, then disconnect and secure the cable from terminal 4 (earth) of the undervolt unit. Refit the terminal cover, then close and secure the circuit breaker panel.

(2) Test

(a) Make available electrical ground power as detailed in 24-41-00.

(b) On the electrical generating control panel, ensure that all four TRU control switches and the DC NORM/SPLIT control switch are at NORM, then set BATT A and BATT B control switches to "ON". Check that -

b1) only the captions GRND PWR AVAILABLE, CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4, No.3 AC MAIN BUS and No.3 AC ESS BUS are illuminated, and

b2) both 'A' and 'B' system essential/main split magnetic indicators display in-line.

(c) Set Nos.1, 2 and 4 bus-tie breaker (BTB) control switches to "TRIP". Check that -

c1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are illuminated,

c2) the load on the d.c. main busbar is supplied by No.3 TRU as indicated on No.3 TRU ammeter and

c3) both 'A' and 'B' system essential/main split magnetic indicators display cross-line.

NOTE: The loads on the 'A' and 'B' system

essential d.c. busbars will be supplied by the batteries.

(d) Set No.1 BTB control switch to "NORM" and then back to "TRIP", checking that both 'A' and 'B' systems essential/main split magnetic indicators change from cross-line to in-line, and then back to cross-line.

(e) Repeat operation (d) applied in turn to Nos.2 and 4 BTB control switches.

(f) Set BATT A and BATT B control switches to "OFF". Check that the associated magnetic indicators change from in-line to cross-line.

(g) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground supply on.

(h) Gain access to No.3 main undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover and reconnect the cable to terminal 4 (earth) of the undervolt unit, checking the order of the terminal screw washers. Torque-tighten the terminal screw to between 12 and 14 lbf in (0.137 and 0.160 mdaN). Refit the terminal cover. Close and secure the circuit breaker panel.

(i) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT A and BATT B control switches to "ON".

(j) Ensure that Nos.1, 2 and 4 BTB control switches are at TRIP and that No.3 BTB control switch is at NORM, then check that -

j1) Nos.1, 2 and 4 AC MAIN BUS captions and Nos.1, 2 and 4 AC ESS BUS captions are illuminated.

j2) No.3 AC MAIN BUS and No.3 AC ESS BUS captions are extinguished,

j3) the total d.c. load is supplied by No.3 TRU as indicated on No.3 TRU ammeter, and

j4) both 'A' and 'B' essential/main split magnetic indicators display in-line.

(k) Set Nos.1, 2 and 4 BTB control switches to "NORM" and check that -

k1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished,

k2) both 'A' and 'B' essential/main split magnetic indicators remain in-line, and

k3) the total d.c. load is shared by Nos.1, 2, 3 and 4 TRUs as indicated on the associated ammeters.

(3) Conclusion

(a) Set BATT A and BATT B control switches to "OFF".

(b) Switch off and disconnect electrical ground power as detailed in 24-41-00.

(c) Cancel the electrical isolation precautions taken in operation (1)(a) not already superseded by subsequent operations, i.e., remove the warning notices.

F. Test - Battery Charge Control

(1) Prepare

(a) Check that 'A' system and 'B' system batteries are fully charged and correctly installed.

(b) Open the forward underfloor service compartment door 123 AB (Ref. 52-41-11) to permit access to 'A' battery charge controller (1P35) and 'B' battery charge controller (2P35), mounted on the top surface of the weather radar racking in the forward underfloor racking zone.

(c) Make available electrical ground power as detailed in 24-41-00.

(2) Test

(a) Check that the DC NORM/SPLIT switch is set to NORM.

(b) Check that both 'A' and 'B' battery control switches are set to OFF and that the associated 'battery isolate' magnetic indicators display cross-line.

(c) Check at 'A' and 'B' BATT - FAIL/ISOL captions that the ISOL section of each is illuminated and the FAIL section of each is extinguished.

(d) Locate the test button on the 'A' battery charge controller (1P35) and observe the associated BATT - FAIL/ISOL caption. Press, and hold depressed, the test button. Check that, after a period of not less than 3 s or more than 6 s, the FAIL section of the associated BATT - FAIL/ISOL caption is illuminated and that, after a period of not less than 8 s or more than 12 s, the light-emitting diode on the controller is illuminated.

(e) Release the test button on the controller and check that the FAIL section of the associated BATT - FAIL/ISOL caption and the light-emitting diode are extinguished.

(f) Repeat operations (d) and (e) as applied to the 'B' battery charge controller (2P35).

(g) Set the 'A' battery control switch to "ON". Check that the ISOL section of the associated BATT - FAIL/ISOL caption is extinguished, the FAIL section remains extinguished and the associated 'battery isolate' magnetic indicator displays in-line.

(h) Set the 'A' battery control switch to "NORM" and check that the ISOL and FAIL sections of the associated BATT - FAIL/ISOL caption remain extinguished. Check also that the associated 'battery isolate' magnetic indicator displays in-line for a period of not less than 5 min.

NOTE: When the battery control switch is set at NORM, battery connection to and disconnection from the essential d.c. busbar are determined by the battery charge controller. The controller senses the battery charge state and if this has

reached an acceptable level the battery will be automatically isolated after the initial 5 min time delay. Isolation is indicated by a cross-line display on the 'battery isolate' magnetic indicator. If the battery charge state has not reached an acceptable level, the automatic isolation of the battery will be delayed accordingly.

R (i) Repeat operations (g) and (h) as applied to
the 'B' battery control switch.

R (j) Observe the battery isolate magnetic indicators
R and wait for a cross-line display to indicate
R that automatic isolation of both 'A' and 'B'
R batteries has been effected, then set the
R DC NORM/SPLIT control switch to "SPLIT".
Check that both 'A' and 'B' essential/main
split magnetic indicators display cross-
line and that both 'A' and 'B' 'battery isolate'
R magnetic indicators display in-line.

R (k) Set the DC NORM/SPLIT control switch to
"NORM" and check that both 'A' and 'B'
essential/main split magnetic indicators
display in-line.

R (l) Set both 'A' and 'B' battery control switches
R to "OFF".

(3) Conclusion

(a) Close the forward underfloor service compartment door (123 AB) (Ref. 52-41-11).

(b) Switch off and disconnect electrical ground power as detailed in 24-41-00.

R **ON A/C 001-006,

DC GENERATION - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains the DC Generation System Test, which is a comprehensive test carried out at major maintenance periods of the aircraft. Operational and Functional Tests are not included since the checks of the DC Generation System that are required under each of these headings are incorporated in the Operational Test and Functional Test given under the General section (Ref. 24-00-00, Adjustment/Test).

The tests applicable to the associated battery venting system are separately contained in Chapter 21 (Ref. 21-23-00, Adjustment/Test).

For convenience of application, the System Test is divided into a series of tests identified under separate sub-headings as follows:-

Test - Preliminary (Control and Indication Circuits)

Test - TRU (Transformer Rectifier Units) Overheat Warning Circuits

Test - TRU Operation and Load Distribution

Test - DC Essential/Main Split - AC Undervolt Control

At the conclusion of individual tests certain operations, e.g., cancelling electrical isolation precautions or switching off electrical ground power, may be omitted, provided that a sequential test validates the omission.

2. System Test

WARNING: THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THE FOLLOWING TEST PROCEDURES.

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

WHEN EITHER BATTERY CONTROL SWITCH IS SET TO "BATT ON" OR "ESS/MAIN SPLIT" IN THE ABSENCE OF

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AIRCRAFT-GENERATED OR EXTERNAL POWER SUPPLIES, THE SELECTED BATTERY ALONE SUPPLIES ALL LOADS STANDING ON THE ASSOCIATED ESSENTIAL D.C. BUSBAR. THE BATTERY CONTROL SWITCHES SHOULD THEREFORE BE SET TO "BATT ON" OR "ESS/MAIN SPLIT" ONLY FOR THE MINIMUM PERIOD REQUIRED TO COMPLETE ANY TEST OPERATION APPLICABLE BEFORE EXTERNAL POWER IS CONNECTED TO THE SYSTEM.

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Precision-grade d.c. voltmeter calibrated to provide accurate readings in the range of 0 to 30 V d.c., required for Preliminary Test	-
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN), required for DC Essential/Main Split - AC Undervolt Control Test	-

B. Test - Preliminary (Control and Indication Circuits)

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) On the electrical generating control panel, check that -

c1) BATT A and BATT B control switches are both at BATT OFF, and the DC VOLTS selector switch is at BATT A,

c2) the emergency generator control switch is at AUTO,

c3) all captions are extinguished,

c4) all magnetic indicators display cross-line,

c5) the four TRU ammeters indicate zero,

c6) the DC VOLTS meter indicates 24 V approx., and

c7) the BATT A and BATT B ammeters both indicate zero.

**ON A/C 001-001,

(d) Trip the BATT A INDICATION circuit breaker D124 on panel 16-215, and fit a safety clip.

(e) Trip the BATT B INDICATION circuit breaker D125. on panel 16-216, and fit a safety clip.

R **ON A/C 002-006,

(d) Trip the BAT A V/METER SUP circuit breaker D124 on panel 16-215, and fit a safety clip.

(e) Trip the BAT B V/METER SUP circuit breaker D125 on panel 16-216, and fit a safety clip.

R **ON A/C 001-006,

(f) Connect the precision-grade d.c. voltmeter to pins A (+ve) and B (-ve) of the d.c. test socket D128-A on panel 18-216.

(2) Test

(a) Remove the safety clip and reset the circuit breaker tripped in operation (1)(d). Check that -

a1) the voltage of battery A is indicated on the d.c. test voltmeter connected at the d.c. test socket, and

a2) the voltage indication given on the aircraft DC VOLTS meter is consistent with the indication given on the test voltmeter.

NOTE: With a fully charged battery installed the d.c. voltage indicated on the test voltmeter should not be less than 24 V.

The calibration tolerance for the aircraft

DC VOLTS meter is ±2.5 per cent of the full scale deflection.

(b) Set the DC VOLTS selector switch to "BATT B" and check that the indications given on the d.c. test voltmeter and the aircraft DC VOLTS meter fall to zero.

(c) Remove the safety clip and reset the circuit breaker tripped in operation (1)(e).
Check that -

c1) the voltage of battery B is indicated on the d.c. test voltmeter connected at the test socket, and

c2) the voltage indication given on the aircraft DC VOLTS meter is consistent with the indication given on the test voltmeter.

NOTE: With a fully charged battery installed, the d.c. voltage indicated on the test voltmeter should not be less than 24 V.

(d) Set the DC VOLTS selector switch to "ESS A" and check that the indications given on the d.c. test voltmeter and the aircraft DC VOLTS meter fall to zero.

(e) Set BATT A control switch to "BATT ON". Check that battery A is connected to the 'A' system essential d.c. busbar by observing that -

e1) the 'A' system 'battery isolate' magnetic indicator changes from cross-line to in-line,

e2) both essential/main split magnetic indicators remain cross-line,

e3) both 'A' and 'B' system BATT ISOLATE captions and the 'A' system DC ESS BUS caption remain extinguished,

e4) the 'B' system DC ESS BUS caption and the DC MAIN BUS caption are illuminated,

e5) battery A voltage is indicated on the D.C. VOLTS meter,

e6) the BATT A ammeter indicates a load (discharge) current reflecting the aircraft loads standing on the 'A' system d.c. essential busbar, and

e7) the captions CSD 1, CSD 2, GEN 1, GEN 2, No.1 AC MAIN BUS, No.2 AC MAIN BUS, No.1 AC ESS BUS and No.2 AC ESS BUS are illuminated.

(f) Set BATT A control switch to "ESS/MAIN SPLIT" and check that the indications required at e1) to e7), inclusive, under operation (e) remain unchanged.

(g) Set the DC VOLTS selector switch to "ESS B" and check that the indications given on the DC VOLTS meter fall to zero.

(h) Set BATT A control switch to "BATT OFF". Check that battery A is disconnected from the 'A' system d.c. essential busbar by observing that -

h1) the 'A' system 'battery isolate' magnetic indicator changes from in-line to cross-line,

h2) both 'A' and 'B' systems BATT ISOLATE captions, and the 'A' system DC ESS BUS caption remain extinguished,

h3) the 'B' system DC ESS BUS caption and the DC MAIN BUS caption are extinguished,

h4) the load (discharge) current indication on BATT A ammeter falls to zero, and

h5) the captions CSD 1, CSD 2, GEN 1, GEN 2, No.1 AC MAIN BUS, No.2 AC MAIN BUS, No.1 AC ESS BUS and No.2 AC ESS BUS are extinguished.

(i) Set BATT B control switch to "BATT ON". Check that battery B is connected to the 'B' system essential d.c. busbar by observing that -

i1) the 'B' system 'battery isolate' magnetic indicator changes from cross-line to in-line,

i2) both essential/main split magnetic

indicators remain cross-line,

i3) both 'A' and 'B' systems BATT ISOLATE captions, the 'B' system DC ESS BUS caption, and the DC MAIN BUS caption remain extinguished,

i4) the 'A' system DC ESS BUS caption is illuminated,

i5) battery B voltage is indicated on the DC VOLTS meter,

i6) the BATT B ammeter indicates a load (discharge) current reflecting the loads standing on the 'B' system d.c. essential busbar, and

i7) the captions CSD 3, CSD 4, GEN 3, GEN 4, No.3 AC MAIN BUS, No.4 AC MAIN BUS, No.3 AC ESS BUS and No.4 AC ESS BUS are illuminated.

(j) Set BATT B control switch to "ESS/MAIN SPLIT" and check that the indications required at i1) to i7), inclusive, under operation (i) remain unchanged.

(k) Set the DC VOLTS selector switch to "MAIN A" and check that the indications on the DC VOLTS meter fall to zero.

(l) Set BATT B control switch to "BATT OFF". Check that battery B is disconnected from the 'B' system d.c. essential busbar by observing that -

l1) the 'B' system 'battery isolate' magnetic indicator changes from in-line to cross-line,

l2) both 'A' and 'B' system BATT ISOLATE captions, the 'B' system DC ESS BUS caption and the DC MAIN BUS caption remain extinguished,

l3) the 'A' system DC ESS BUS caption is extinguished,

l4) the load (discharge) current indication on BATT B ammeter falls to zero, and

l5) the captions CSD 3, CSD 4, GEN 3, GEN 4,

No.3 AC MAIN BUS, No.4 AC MAIN BUS, No.3 AC ESS BUS and No.4 AC ESS BUS are extinguished.

(3) Conclusion

(a) Disconnect and remove the precision-grade voltmeter from the d.c. test socket D128-A on panel 18-216.

(b) Cancel the electrical isolation precautions taken in operation (1)(a), not already superseded by subsequent operations, i.e., remove the warning notices.

C. Test - TRU (Transformer Rectifier Units) Overheat Warning Circuits

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) Trip the following circuit breakers. Fit safety clips to each tripped circuit breaker.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
TRU O/HEAT IND	1-213	P7	N8
NO.1 TRU SUP	2-213	1P1	B20
NO.4 TRU SUP	4-213	4P1	F14
NO.2 TRU SUP	21-215	2P1	-
NO.3 TRU SUP	21-216	3P1	-

(d) Open the forward underfloor service compartment door 123 AB (Ref. 52-41-11) to permit access to Nos.1, 2, 3 and 4 TRUs on panel 4-123 in the forward underfloor racking.

(e) Disconnect the input electrical connector from each TRU. Using a suitable cable link, connect pin 4 of each 'free' connector (1P4-A, 2P4-A, 3P4-A and 4P4-A) to a convenient earth point.

(2) Test

(a) Remove the safety clip and reset the TRU O/HEAT IND circuit breaker P7 on panel 1-213, map ref.N8

(b) Set BATT A control switch to "BATT ON". Ignoring all other indications on the electrical generating control panel, check that -

b1) the 'A' system 'battery isolate' magnetic indicator changes from cross-line to in-line and

b2) Nos.1, 2, 3 and 4 TRU O/HEAT captions are illuminated.

(c) Set BATT A control switch to "BATT OFF". Check that -

c1) the 'A' system 'battery isolate' magnetic indicator changes from in-line to cross-line, and

c2) Nos.1, 2, 3 and 4 TRU O/HEAT captions are extinguished.

(3) Conclusion

(a) Trip the TRU O/HEAT IND circuit breaker P7 on panel 1-213, map ref.N8, and fit a safety clip.

(b) Remove the cable links connecting pin 4 to earth at each TRU input 'free' connector (1P4-A, 2P4-A, 3P4-A and 4P4-A) and reconnect each connector to the associated TRU, ensuring that the mating surfaces are clean and undamaged.

(c) Remove the safety clips and reset all the circuit breakers listed in paragraph (1)(c).

(d) Cancel the electrical isolation precautions taken in operation (1)(a), not already superseded by subsequent operations, i.e., remove the warning notices.

(e) Close and secure the forward underfloor service compartment door 123 AB (Ref. 52-41-11).

(f) Make available electrical ground power as detailed in 24-41-00. Check that the total d.c. load is shared by Nos.1, 2, 3 and 4 TRUs as indicated on the associated ammeters.

(g) Switch off and disconnect electrical ground power as detailed in 24-41-00.

D. Test - TRU Operation and Load Distribution

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) Gain access to No.1 TRU reverse current circuit breaker (RCB), 1P18 on shelf 12-215, by opening the appropriate circuit breaker panel. Trip the RCB by depressing the mechanical trip button at the side of the rubber boot enclosing the mechanical reset lever on top of the unit. Close and secure the circuit breaker panel.

(d) Gain access to No.4 TRU RCB, 2P18 on shelf 12-216, by opening the appropriate circuit breaker panel. Trip the RCB by depressing the mechanical trip button at the side of the rubber boot enclosing the mechanical reset lever on top of the unit. Close and secure the circuit breaker panel.

(e) Open the forward underfloor service compartment door 123 AB (Ref. 52-41-11) to permit access to Nos.1, 2, 3 and 4 TRUs on panel 4-123 in the forward underfloor racking.

(2) Test

(a) Make available electrical ground power as detailed in 24-41-00.

(b) On the electrical generating control panel, ensure that -

b1) BATT A and BATT B control switches are at BATT OFF, the associated 'battery isolate' magnetic indicators display cross-line, and the essential/main split magnetic indicators display in-line,

b2) all four TRU control switches are at NORM, and

b3) only the captions GRND PWR AVAILABLE, CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and both BATT ISOLATE captions are illuminated.

(c) Check at No.1, No.2, No.3 and No.4 TRUs that the cooling fan in each TRU is working.

NOTE: There is no visual indication of TRU fan operation, but it is practicable to check that the fan is working by using the hand to sense the expulsion of ventilating air from the openings in the lower periphery of the TRU.

(d) Select and switch on aircraft d.c. loads up to but not exceeding 120 A, checking that -

d1) the total d.c. load is shared by Nos.2 and 3 TRUs, as indicated on the associated ammeters, and

d2) the readings on both Nos.1 and 4 TRU ammeters are zero.

(e) Set the DC VOLTS selector switch to "ESS A", then in turn to "MAIN A", "MAIN B" and "ESS B", checking at each switch position that approximately 28 V is indicated on the DC VOLTS meter, i.e., nominal d.c. voltage.

(f) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground power supply on.

(g) Gain access to No.1 TRU RCB, 1P18 on shelf 12-215, by opening the appropriate circuit breaker panel. Reset the RCB by depressing the mechanical reset lever enclosed in the rubber boot at the top of the unit. Close and secure the circuit breaker panel.

(h) Gain access to No.4 TRU RCB, 2P18 on shelf 12-216, by opening the appropriate circuit breaker panel. Reset the RCB by depressing the mechanical reset lever enclosed in the rubber boot at the top of the unit. Close and secure the circuit breaker panel.

(i) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Check that -

i1) the total d.c. load is shared by Nos.1, 2, 3 and 4 TRUs, as indicated on the associated ammeters,

i2) both 'A' and 'B' system essential/main split magnetic indicators display in-line, and

i3) approximately 28 V is indicated on the DC VOLTS meter, i.e., nominal d.c. voltage.

(j) Set BATT A and BATT B control switches to "BATT ON". Check that both 'A' and 'B' system BATT ISOLATE captions are extinguished.

(k) Set the DC VOLTS selector switch to "MAIN A", then set each TRU control switch, in turn, to "ISOL" and check that each TRU ammeter reading falls to zero as the associated ISOL selection is made. When all four TRUs are isolated, check that -

k1) the readings on the DC VOLTS meter fall to zero,

k2) both 'A' and 'B' system essential/main split magnetic indicators change from in-line to cross-line, and

k3) the DC MAIN BUS caption is illuminated.

NOTE: Isolation of the d.c. main busbar is initiated by undervolt detectors that have an inverse time delay and, normally, d.c. main busbar isolation will occur between 2 and 10 s after the last TRU is switched off.

(l) Return all four TRU control switches to "NORM". Check that -

(l1) both 'A' and 'B' system essential/main split magnetic indicators change from cross-line to in-line,

(l2) the DC MAIN BUS caption is extinguished, and

(l3) the DC VOLTS meter registers the nominal d.c. voltage.

(m) Set BATT A control switch to "ESS/MAIN SPLIT" and then back to "BATT ON", checking that the 'A' system essential/main split magnetic indicator changes to cross-line and then back to in-line.

(n) Set BATT B control switch to "ESS/MAIN SPLIT" and then back to "BATT ON", checking that the 'B' system essential/main split magnetic indicator changes to cross-line and then back to in-line.

(o) Set BATT A and BATT B control switches to "BATT OFF". Check that the associated magnetic indicators change from in-line to cross-line.

(3) Conclusion

(a) Switch off and disconnect electrical ground power as detailed in 24-41-00.

(b) Cancel the electrical isolation precautions taken in operation (1)(a), not already superseded by subsequent operations, i.e., remove the warning notices.

(c) Close and secure the forward underfloor service compartment door 123 AB (Ref. 52-41-11).

E. Test - DC Essential/Main Split - AC Undervolt Control

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Check that the 'A' system and 'B' system batteries are fully charged and correctly installed.

(c) Gain access to No.3 main a.c. undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover, then disconnect and secure the cable from

terminal 4 (earth) of the undervolt unit. Refit the terminal cover, then close and secure the circuit breaker panel.

(2) Test

(a) Make available electrical ground power as detailed in 24-41-00.

(b) On the electrical generating control panel, ensure that all four TRU control switches are at NORM, then set BATT A and BATT B control switches to "BATT ON". Check that -

b1) only the captions GRND PWR AVAILABLE, CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4, No.3 AC MAIN BUS and No.3 AC ESS BUS are illuminated, and

b2) both 'A' and 'B' system essential/main split magnetic indicators display in-line.

(c) Set Nos.1, 2 and 4 bus-tie breaker (BTB) control switches to "TRIP". Check that -

c1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are illuminated,

c2) the load on the d.c. main busbar is supplied by No.3 TRU as indicated on No.3 TRU ammeter and

c3) both 'A' and 'B' system essential/main split magnetic indicators display cross-line.

NOTE: The loads on the 'A' and 'B' system essential d.c. busbars will be supplied by the batteries.

(d) Set No.1 BTB control switch to "NORM" and then back to "TRIP", checking that both 'A' and 'B' systems essential/main split magnetic indicators change from cross-line to in-line, and then back to cross-line.

(e) Repeat operation (d) applied in turn to Nos.2 and 4 BTB control switches.

(f) Set BATT A and BATT B control switches to "BATT OFF". Check that the associated magnetic

indicators change from in-line to cross-line.

(g) Switch off the ground power supply at source and place a warning placard on the ground power rig forbidding any attempt to switch the ground supply on.

(h) Gain access to No.3 main undervolt unit 3X15 on shelf 12-216 by opening the appropriate circuit breaker panel. Remove the terminal cover and reconnect the cable to terminal 4 (earth) of the undervolt unit, checking the order of the terminal screw washers. Torque-tighten the terminal screw to between 12 and 14 lbf in (0.137 and 0.160 mdaN). Refit the terminal cover. Close and secure the circuit breaker panel.

(i) Remove the warning placard, switch on the ground power supply at source and reconnect ground power by setting the ground power control switch to "CLOSE" and releasing it. Set BATT A and BATT B control switches to "BATT ON".

(j) Ensure that Nos.1, 2 and 4 BTB control switches are at TRIP and that No.3 BTB control switch is at NORM, then check that -

j1) Nos.1, 2 and 4 AC MAIN BUS captions and Nos.1, 2 and 4 AC ESS BUS captions are illuminated.

j2) No.3 AC MAIN BUS and No.3 AC ESS BUS captions are extinguished,

j3) the total d.c. load is supplied by No.3 TRU as indicated on No.3 TRU ammeter, and

j4) both 'A' and 'B' essential/main split magnetic indicators display in-line.

(k) Set Nos.1, 2 and 4 BTB control switches to "NORM" and check that -

k1) Nos.1, 2, 3 and 4 AC MAIN BUS captions and Nos.1, 2, 3 and 4 AC ESS BUS captions are extinguished,

k2) both 'A' and 'B' essential/main split magnetic indicators remain in-line, and

k3) the total d.c. load is shared by Nos.1, 2, 3 and 4 TRUs as indicated on the associated ammeters.

(3) Conclusion

(a) Set BATT A and BATT B control switches to "BATT OFF".

(b) Switch off and disconnect electrical ground power as detailed in 24-41-00.

(c) Cancel the electrical isolation precautions taken in operation (1)(a) not already superseded by subsequent operations, i.e., remove the warning notices.

BATTERY - MAINTENANCE PRACTICES

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 12-00-00.

1. Servicing

WARNING: UNDER NO CIRCUMSTANCES SHOULD ANY ATTEMPT BE MADE TO REPLENISH THE ELECTROLYTE OR INTRODUCE ANY SUBSTANCE, E.G. ACID, DISTILLED WATER OR ALKALI, TO THE BATTERY.

CAUTION: AVOID CONTACT BETWEEN THE BATTERY AND FLUIDS WHICH MAY DAMAGE THE POLYESTER BONDED GLASS FIBRE CASE.

NOTE: The battery is maintenance free with respect to electrolyte replenishment.

A. General Servicing

(1) Inspect the battery for cleanliness, security of mounting and security of electrical connector, correct lubrication of the terminals and freedom from damage, corrosion and water/dirt ingress. If necessary, clean using the approved cleaning material (Ref. 20-30-00).

(2) Inspect the battery vent pipe connection for security and the vent pipe for freedom from obstruction or damage throughout its length.

BATTERY - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00, SERVICING.

1. General

CAUTION: DISCONNECTION OF THE ELECTRICAL CONNECTOR FROM THE 'A' SYSTEM BATTERY ELECTRICALLY ISOLATES THE GROUND CALL HORN, THEREBY PREVENTING AUTOMATIC OPERATION OF THE HORN AS A WARNING IN THE EVENT OF EQUIPMENT BAY COOLING FAILURE (REF. 21-21-00).

A. The two batteries, one in 'A' and one in 'B' system, are housed in the battery boxes, 19-215 and 19-216 respectively, of the LH and RH flight compartment racking. Each battery is clamped to a two-wheeled tray which is secured in the box by two bolts and washers at the front and by two hold-down spigots at the rear. Electrical and ventilation connections are made through appropriate connectors on the front of the battery case. The tray, complete with battery, cannot be withdrawn from the box until the electrical and ventilation connectors have been disconnected.

B. The following removal and installation procedures apply to both 'A' and 'B' system batteries.

2. Battery

**ON A/C 007-007,

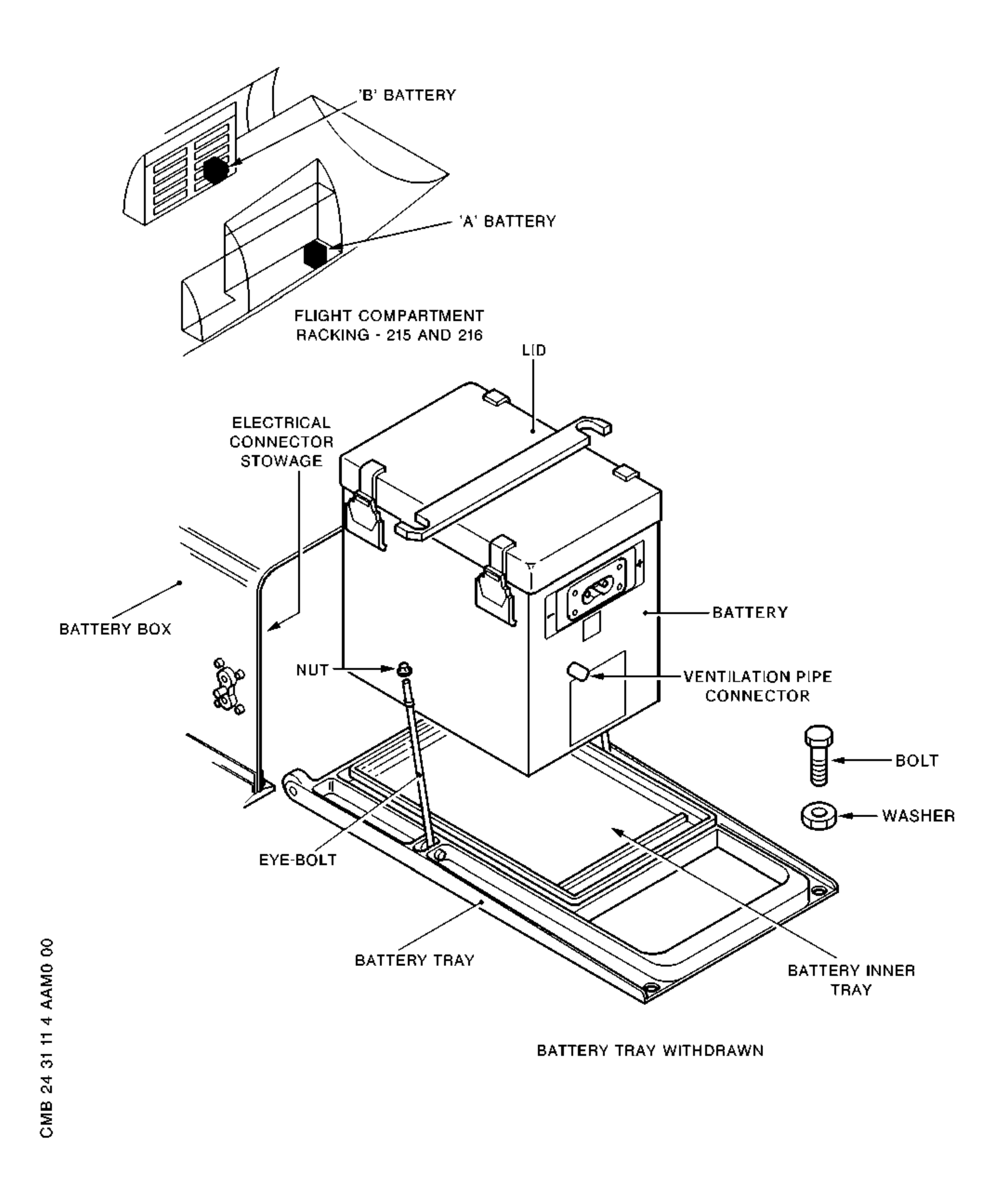
(Ref. Fig.401)

**On A/C 001-006,

(Ref. Fig.402)

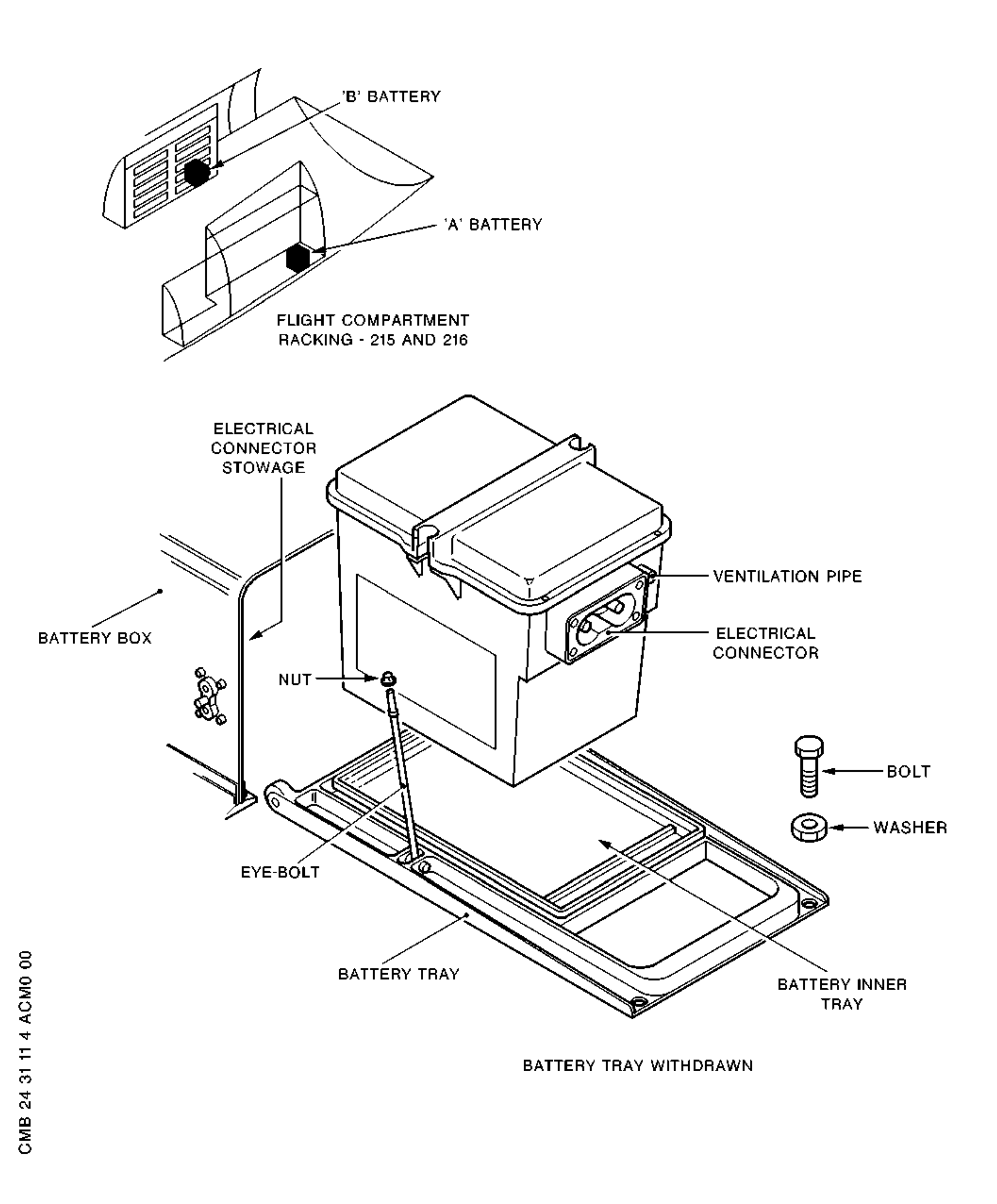
A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 36 lbf in (0.4068 mdaN)	-
Torque spanner, 60 to 70 lbf in (0.678 to 0.791 mdaN)	-



Battery Installation
Figure 401

PRINTED IN ENGLAND



Battery Installation
Figure 402

**ON A/C 007-007,

B. Prepare

(1) Ensure that BATT A and BATT B control switches are at OFF. If battery 'A' is to be removed, trip the GRND CALL HORN SUP & CONT circuit breaker H1216 on panel 16-215, and fit a safety clip.

(2) Place a warning placard on the appropriate battery control switch forbidding movement of the switch from the OFF position.

**ON A/C 001-005,

B. Prepare

(1) Ensure that BATT A and BATT B control switches are at BATT OFF.

(2) Trip the BATT A CONT circuit breaker, 1P24 on panel 16-215 or the BATT B CONT circuit breaker 2P24 on panel 16-216, and fit a safety clip.

(3) Place a warning placard on the appropriate battery control switch forbidding movement of the switch from the OFF position.

**ON A/C 006-006,

B. Prepare

(1) Ensure that BATT A and BATT B control switches are at BATT OFF.

(2) Trip the BATT A CONT circuit breaker, 1P24 on panel 16-215 or the BATT B CONT circuit breaker 2P24 on panel 16-216, and fit a safety clip. If battery 'A' is to be removed, trip the GRND CALL HORN SUP & CONT circuit breaker H1216 on panel 16-215, and fit a safety clip.

(3) Place a warning placard on the appropriate battery control switch forbidding movement of the switch from the OFF position.

C. Remove

(1) Gain access to the battery by removing the appropriate panel from the flight compartment racking.

(2) Disconnect the electrical connector from the battery.

(3) Disconnect the ventilation pipe from the battery and fit a suitable blank over the end of the ventilation pipe.

(4) Remove the two bolts and washers securing the front of the battery tray to the battery box.

(5) Take the weight at the front of the tray and withdraw the tray from the battery box.

(6) Loosen the nuts on the eye-bolts and move the eye-bolts clear of the battery lid.

(7) Lift the battery, complete with lid, from the tray.

(8) Fit the electrical connector to its stowage.

D. Install

(1) Comply with the electrical safety precautions.

B

B (2) Carry out the following inspection prior to battery fitment:

B **ON A/C 001-006,

RB (a) Inspect in accordance with 24-31-11, Maintenance
RB Practices, para. 1.A.(1).

B **ON A/C 007-007,

B (a) Inspect in accordance with 24-31-11, Conf.01,
B Inspection/Check, para. 2.B.

(3) Disconnect the electrical connector from its stowage.

(4) Place the battery on the inner tray of the battery tray with the electrical connector facing the front of the tray.

(5) Ensure that the battery lid is correctly positioned. Fit the eye-bolts in the lugs on the lid and tighten the nuts. Torque-tighten the nuts to 36 lbf in (0.4068 mdaN).

(6) Take the weight at the front of the battery tray and insert the tray into the battery box until the hold-down spigots on the box engage the holes in the rear of the tray.

(7) Secure the front of the tray with the two bolts and washers. Torque-tighten the bolts to between 60 and 70 lbf in (0.678 and 0.791 mdaN). Check the electrical bonding in accordance with 20-27-11.

(8) Remove the blank from the end of the ventilation pipe and connect and secure the ventilation pipe to the battery.

(9) Connect and secure the electrical connector to the battery, ensuring that the mating surfaces are clean and undamaged.

(10) Refit and secure the panel to the racking.

(11) Set the DC VOLTS selector switch to the appropriate "BATT A" or "BATT B" position and check that the d.c. voltmeter indicates 24 V, approximately.

**ON A/C 007-007,

(12) Remove the safety clip, reset the circuit breaker tripped in para. 2.B.(1) and remove the warning placard from the battery control switch.

**ON A/C 001-005,

(12) Remove the safety clip, reset the circuit breaker tripped in 2.B.(2) and remove the warning placard from the battery control switch.

**ON A/C 006-006,

(12) Remove the safety clip(s), reset the circuit breaker(s) tripped in 2.B.(2) and remove the warning placard from the battery control switch.

R **ON A/C 007-007,

BATTERY - INSPECTION/CHECK

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

DUE TO THE HIGH CURRENT CAPACITY OF NICKEL/CADMIUM BATTERIES, METAL JEWELLERY, RINGS, WRIST BANDS, ETC., CONSTITUTE A DANGER AND MUST BE REMOVED.

1. General

This topic contains only the inspection necessary to ascertain whether the physical condition of the battery and electrical connector is satisfactory. Checks of the battery venting system are separately contained in 21-23-00.

2. Inspection

A. Prepare

(1) Withdraw the battery tray as detailed in Removal/Installation.

(2) Remove the battery hold-down cover. Do not remove the battery from the tray.

B. Inspect

(1) Inspect the battery case for freedom from distortion or local bulges.

(2) Inspect the tops of the cells for freedom from moisture and electrolyte deposits.

(3) Inspect the cell connecting links for evidence of overheating or corrosion.

(4) Inspect the battery connector pins for cleanliness, security and freedom from corrosion.

(5) Inspect the exterior of the non-return valve for security and cleanliness.

C. Conclusion

(1) Fit the hold-down cover on the battery.

(2) Complete the installation of the battery as

detailed in Removal/Installation.

TRANSFORMER RECTIFIER UNIT- REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The four transformer rectifier units (TRUs) are mounted on the forward underfloor racking panel 4-123, each TRU being attached to the panel by three bolts and wire-locking washers. The 200/115 V 3-phase input connections for each TRU are made through an electrical connector on the lower periphery of the TRU case, and the 28 V d.c. output connections are made through two terminals located between the TRU cooling fins. The terminals are protected by a cover attached by a captive nut.

The following removal and installation procedures apply to any one of the four TRUs.

NOTE: Removal of a rear-mounted TRU necessitates the removal of the forward-mounted TRU to gain access.

2. Transformer Rectifier Unit

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque spanner, 25 to 30 lbf in (0.282 to 0.339 mdaN)	-
Torque spanner, 50 to 55 lbf in (0.565 to 0.621 mdaN)	-
Torque spanner, 80 to 90 lbf in (0.904 to 1.017 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(2) Trip the circuit breakers listed below and fit a safety clip to each tripped circuit breaker.

SERVICES	PANEL	CIRCUIT BREAKER	MAP REF.
NO.1 TRU SUP	2-213	1P1	B20
NO.2 TRU SUP	21-215	2P1	-
NO.3 TRU SUP	21-216	3P1	-
NO.4 TRU SUP	4-213	4P1	F14

(3) Ensure that the BATT A and BATT B control switches are at OFF.

(4) Open the forward underfloor service compartment door, 123 AB (Ref. 52-41-11), to gain access to the forward underfloor racking.

C. Remove

(1) Disconnect the electrical connector from the TRU.

(2) Remove the terminal protection cover and disconnect the electrical cables from the terminals on the TRU.

(3) Refit the terminal protection cover.

(4) Cut the wire-locking and remove the bolts and wire-locking washers securing the TRU to the panel. Remove the TRU.

D. Install

B NOTE: Prior to installation, on aircraft G-BOAG only,
RB remove TRU side cover and carefully move the voltage
B adjustment link to the "MID" (intermediate)
B position. Replace the cover and install on
RB aircraft.

(1) Comply with electrical safety precautions.

(2) Place the TRU on its mounting and secure it to the panel with the bolts and wire-locking washers. Torque-tighten the securing bolts to between 25 and 30 lbf in (0.282 and 0.339 mdaN) and wire-lock the bolts in accordance with 20-21-13. Ensure that the unit is bonded in accordance with 20-27-11.

(3) Remove the terminal protection cover and connect the electrical cables to the terminals on the TRU, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the +ve terminal nut to between 80 and 90 lbf in (0.904 and 1.017 mdaN) and the -ve terminal nut to between 50 and 55 lbf in (0.565 and 0.621)mdaN).

(4) Refit the terminal protection cover.

(5) Connect the electrical connector to the TRU, ensuring that the mating surfaces are clean and undamaged.

E. Conclusion

(1) Close and secure the forward underfloor service compartment door, 123 AB (Ref. 52-41-11).

(2) Remove the safety clips and reset the circuit breakers tripped before removal.

(3) Carry out an Operational Test of the TRU (Ref. Adjustment/Test).

TRANSFORMER RECTIFIER UNIT - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The following Operational Test is primarily intended to check a transformer rectifier unit (TRU) after installation to confirm that it is operating correctly in the system. Functional and System Tests are not considered necessary in this application.

2. Operational Test

A. Prepare

(1) Ensure that the Nos.1, 2, 3 and 4 TRU NORM/ISOL and the NORM/EMERG switches are set to NORM.

(2) Check that the TRU voltage adjustment link is in the bottom (MIN) position. The link can be observed through inspection windows in the voltage and adjustment link protective cover.

R B NOTE: On aircraft G-BOAG only the voltage adjustment
R B link must be in the "MID" position. If the
R B link requires changing, observe electrical
R B safety precautions before removing TRU top
R B cover. Turn top cover screw by ¼ turn and
R B lift carefully. Move the link to the "MID"
R B position and replace the cover. Continue
R B adjustment/test.

(3) Ensure that the BATT A and BATT B control switches are set to OFF.

(4) Make available electrical ground power as detailed in 24-41-00.

(5) Check that the DC MAIN BUS caption and both DC ESS BUS captions are extinguished, and the d.c. essential/main split magnetic indicators display in-line.

(6) Check that all four AC MAIN BUS and AC ESS BUS captions are extinguished, and the a.c. essential/main isolate magnetic indicators display in-line.

(7) Open the forward underfloor service compartment door, 123 AB (Ref. 52-41-11), to gain access to the TRUs.

(8) Ensure that the appropriate TRU internal cooling fan is working, by checking that ventilation air is being expelled through the openings in the lower periphery of the unit.

B. Test

<u>CAUTION</u>: THE POSITION OF THE VOLTAGE ADJUSTMENT LINK MUST NOT BE ALTERED. IF A FAULT CONDITION OCCURS THE TRU MUST BE REMOVED FOR INVESTIGATION.

(1) Switch on sufficient d.c. loads to obtain a scale reading on the TRU ammeters.

(2) Check that the Nos.1, 2, 3 and 4 TRU ammeters indicate that the total d.c. load is shared between the four TRUs.

(3) Set the TRU NORM/ISOL switch of the TRU under test to "ISOL" and check that the associated TRU ammeter indicates zero and that the remaining three TRU ammeters indicate that the total d.c. load is now shared between the three associated TRUs.

(4) Return the TRU NORM/ISOL switch to "NORM" and check that the associated TRU ammeter registers a d.c. load and that the total d.c. load is now shared between the four TRUs.

(5) Check that the four TRU O/HEAT captions are extinguished.

C. Conclusion

(1) Switch off and disconnect electrical ground power as detailed in 24-41-00.

(2) Close and secure the forward underfloor service compartment door, 123 AB (Ref. 52-41-11).

TRANSFORMER RECTIFIER UNIT - INSPECTION/CHECK

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The four transformer rectifier units (TRUs) are mounted on the forward underfloor racking panel 4-123. The inspection procedures in this topic are limited to external examination only. The interior components of a TRU cannot be inspected with the TRU in situ.

2. Inspection

A. Prepare

(1) If already connected, ensure that ground power is disconnected from the main a.c. distribution system by operation of the ground power control switch to the TRIP position.

(2) Place a warning placard on the electrical generating control panel forbidding any attempt to set the ground power control switch to the CLOSE position.

(3) Open access door 123 AB (Ref. 52-41-11) to gain access to the forward underfloor racking.

B. Inspect

(1) At each TRU examine all ventilation openings at the top of the casing and around the lower periphery for freedom from clogging or evidence of the ingress of foreign matter.

(2) If there is any clogging of ventilation openings or the ingress of foreign matter is evident, the TRU must be removed (Ref. Removal/Installation) for investigation.

C. Conclusion

(1) Close and secure the access door.

(2) Remove the warning placard from the control panel.

(3) Switch off and disconnect electrical ground power as detailed in 24-41-00.

**ON A/C 007-007,

CHARGE CONTROLLER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The two charge controllers are mounted on the top surface of the weather radar racking, which is situated in the forward underfloor racking zone. Access to the charge controllers is gained through the forward underfloor service compartment door. Electrical connections to a charge controller are made through an electrical connector at the rear of the unit. The removal/installation procedures in this topic are applicable to both charge controllers.

2. Charge Controller

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-

B. Prepare to Remove

CAUTION: IF A FAULT CONDITION HAS REQUIRED RENEWAL OF A CHARGE CONTROLLER, THE ASSOCIATED BATTERY IS SUSPECT AND MUST BE RENEWED. THE REASON FOR REMOVAL OF THE BATTERY MUST BE RECORDED AND RETURNED WITH THE BATTERY.

(1) Refer to the CAUTION. If the battery is suspect renew it (Ref. 24-31-11, Removal/Installation).

(2) Electrically isolate the appropriate charge controller by tripping the associated circuit breakers listed below.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
BAT A CONT	16-215	1P24	-

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
BAT A CHARGE CONT SUP	1-213	1P33	P10
BAT B CONT	16-216	2P24	-
BAT B CHARGE CONT SUP	3-213	2P33	H11

(3) Ensure that the DC NORM/SPLIT control switch is at NORM.

(4) Set the appropriate BATT A or BATT B control switch to "OFF".

C. Remove

(1) Gain access to the charge controllers by opening the forward underfloor service compartment door (123 AB) (Ref. 52-41-11).

(2) Locate the appropriate charge controller on the top surface of the weather radar racking and disconnect the electrical connector from the rear of the unit.

**ON A/C 007-007,

(3) Remove the four screws securing the charge controller to the weather radar racking and remove the unit.

**ON A/C 007-007,

D. Prepare to Install

(1) Ensure that the DC. NORM/SPLIT control switch is at NORM.

(2) Ensure that the associated (BATT A or BATT B) battery control switch is at OFF.

E. Install

(1) Comply with the electrical safety precautions.

**ON A/C 007-007,

(2) Position the charge controller on the weather radar racking and secure it with the screws.

**ON A/C 007-007,

(3) Connect the electrical connector to the charge controller, ensuring that the mating surfaces are clean and undamaged.

(4) Ensure that the charge controller is bonded in accordance with 20-27-11.

F. Conclusion

(1) Remove the safety clips and reset the circuit breakers tripped before removal.

(2) Carry out an Operational Test of the charge controller (Ref. Adjustment/Test).

**ON A/C 007-007,

CHARGE CONTROLLER - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The following Operational Test confirms that the charge controller in either system A or system B, as appropriate, is operating correctly in the system. The test is primarily intended to check the controller after installation. Functional and System Tests are not considered necessary in this application.

2. Operational Test

A. Prepare

(1) Ensure that the associated battery is serviceable and fully charged.

(2) Make available electrical ground power as detailed in 24-41-00.

(3) Open the forward underfloor service compartment door (123 AB) (Ref. 52-41-11) to permit access to 'A' battery charge controller (1P35) or 'B' battery charge controller (2P35), mounted on the top of the weather radar racking in the forward underfloor racking zone.

B. Test

(1) Set the appropriate battery control switch to "OFF".

(2) Check that the DC NORM/SPLIT switch is set to "NORM".

(3) Check that the associated battery isolate magnetic indicator displays cross-line.

(4) Check at the associated BATT - FAIL/ISOL caption on the electrical generating control panel that the ISOL section is illuminated and the FAIL section is extinguished.

(5) Locate the test button on the charge controller and observe the associated BATT - FAIL/ISOL caption. Press, and hold depressed, the test button. Check that, after a period of not less than 3 s or more

than 6 s, the FAIL section of the associated BATT - FAIL/ISOL caption is illuminated, and that, after a period of not less than 8 s or more than 12 s, the light-emitting diode on the controller is illuminated.

(6) Release the controller test button and check that the FAIL section of the associated BATT - FAIL/ISOL caption and the light-emitting diode are extinguished.

(7) Set the appropriate battery control switch to "NORM". Check that the ISOL and FAIL sections of the associated BATT - FAIL/ISOL caption are extinguished and the appropriate system battery isolate magnetic indicator displays in-line.

NOTE: When the battery control switch is set at NORM, battery connection to and disconnection from the essential d.c. busbar are determined by the battery charge controller. The controller senses the battery charge state and if this has reached an acceptable level the battery will be automatically isolated after the initial 5 min time delay. Isolation is indicated by a cross-line display on the 'battery isolate' magnetic indicator. If the battery charge state has not reached an acceptable level, the automatic isolation of the battery will be delayed accordingly.

(8) Observe the appropriate battery isolate magnetic indicator and wait for a cross-line display to indicate that automatic isolation of the battery has been effected, then set the DC NORM/SPLIT switch to "SPLIT". Check that the associated system battery isolate magnetic indicator displays in-line and the associated essential main/split magnetic indicator displays cross-line.

(9) Set the DC NORM/SPLIT switch to "NORM" and check that the associated essential main/split magnetic indicator displays in-line.

(10) Set the battery control switch to "OFF".

E. Conclusion

(1) Close the forward underfloor service compartment door (Ref. 52-41-11).

(2) Switch off and disconnect electrical ground power as

detailed in 24-41-00.

END OF THIS SECTION

NEXT

**ON A/C 001-005,

EXTERNAL POWER - DESCRIPTION AND OPERATION

**ON A/C 001-005,

1. General (Ref. Fig. 001)

200/115 V three-phase 400 Hz a.c. external ground power can be used to supply the main a.c. distribution system (and hence the essential a.c. and the d.c. distribution systems) for aircraft ground servicing and testing or to supply a separate ground services distribution system to provide power for selected ground services only. Ground power is coupled to the aircraft through a ground supply plug situated in a compartment behind an access panel on the right underside of the fuselage approximately 2 ft (0.61 m) rearward from the front face of the nose landing gear bay. To prevent drag on the coupling, the supply plug compartment houses a hinged stirrup (hook) for use with an associated device on the ground power cable.

**ON A/C 001-005,

**ON A/C 001-005,

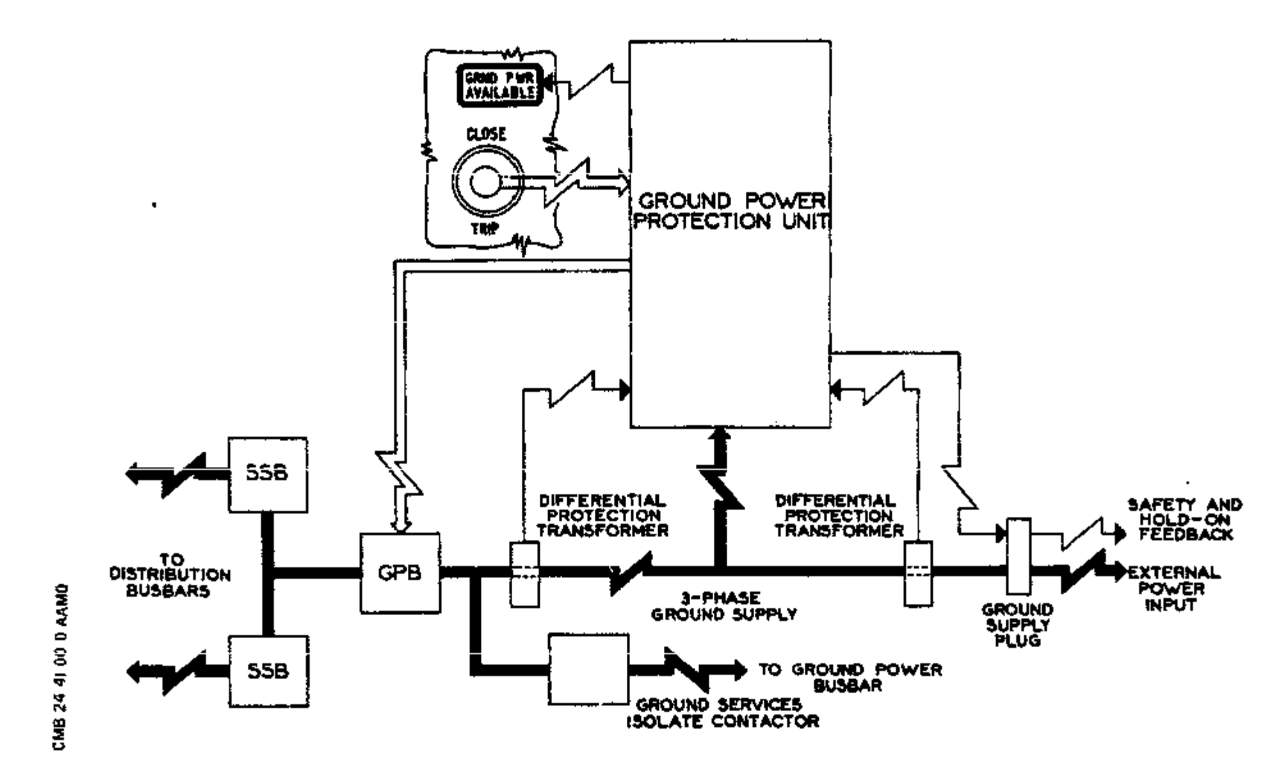
A ground power breaker (GPB) connects the ground supply to the busbars of the main a.c. distribution system and is controlled primarily by a ground power control switch at the third crew member's station. A ground services isolate contactor connects the ground supply to a ground power busbar and is controlled by a ground service control switch on the steward's panel in the forward vestibule. The ground power busbar is the primary supply busbar of the ground services distribution system. This system enables ground power to be distributed to certain circuits, e.g., lighting, refuelling, etc., without further connection of the supply to the main a.c. distribution system through the GPB. Power supplies for the ground hydraulic check-out electric pumps (Ref. 29-23-00) are taken direct from the ground supply plug.

Protection is provided to prevent connection of ground power to the main a.c. distribution system and/or the ground services distribution system if the ground power supply does not meet specific standards of frequency, voltage and phase rotation and, after connection, to disconnect the supply if the standards are not maintained.

In addition, the aircraft ground power feeder cables are

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**ON A/C 001-005,



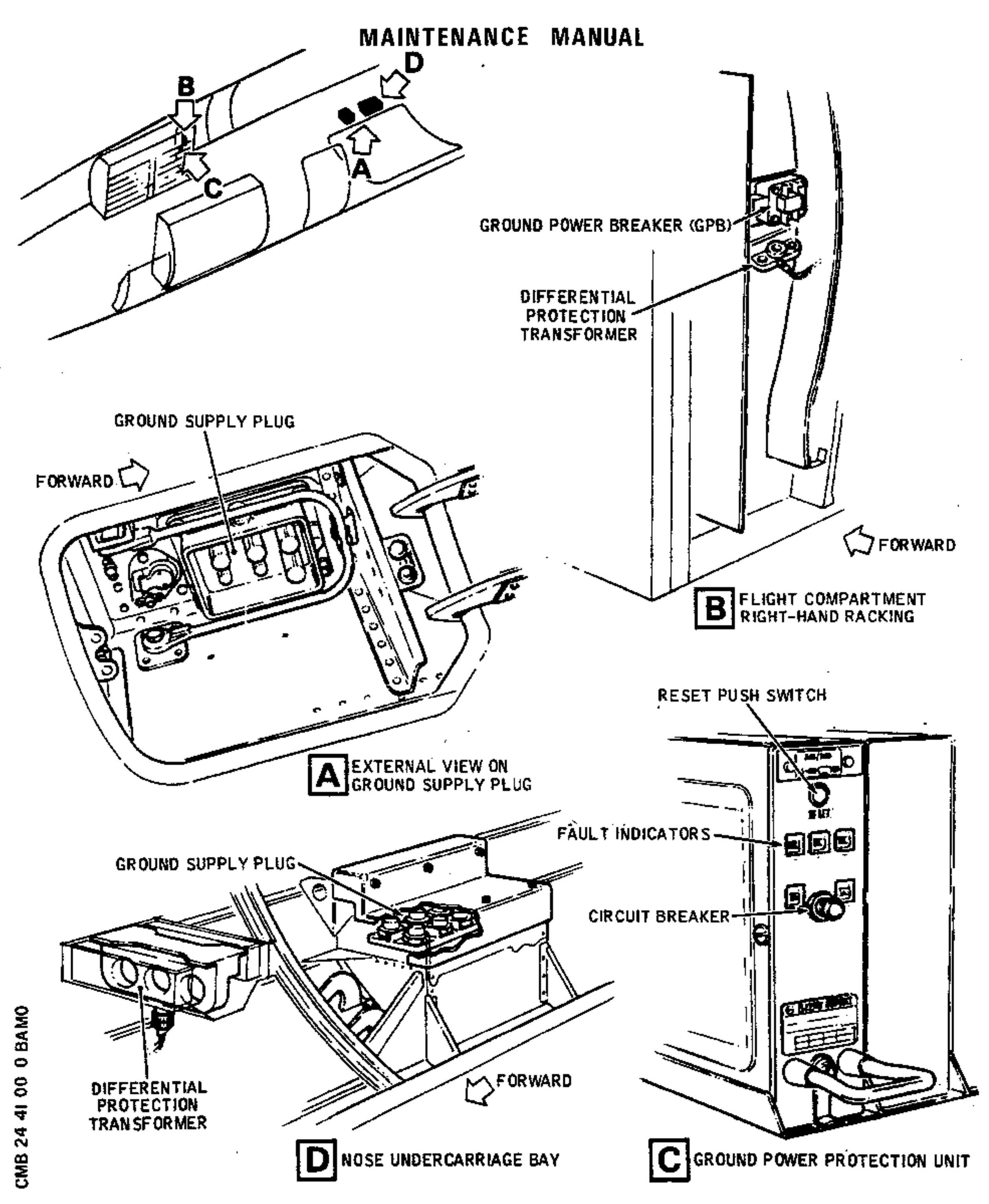
Ground Power
Figure 001

protected so that similar results are produced if a feeder fault is sensed. Protection is also provided to prevent paralleling of main-generated and ground power.

Indication that a satisfactory external supply is present at the ground supply plug, i.e., 'ground power available' is given by a caption light at the third crew member's station and by an amber indicator light in the power supply plug compartment. A second (white) indicator light in the latter position is provided to indicate 'ground power not in use'.

It is important to note that before ground power is connected to the main a.c. distribution system, the equipment bay cooling controls must be set for the normal ground state and that, subject to individual test requirements, distribution circuit breakers identified with a coloured surround must be tripped (Ref. Servicing).

2. Ground Power Protection Unit (Ref. Fig. 002)



Ground Power Equipment
Figure 002

This unit is contained within a 1/4 ATR short case and is located on shelf 1-216 in the flight compartment right-hand racking. The unit senses the incoming ground power supply and prevents connection of ground power to the main a.c. distribution system and/or the ground services distribution system if the ground supply characteristics are outside specified limits.

In addition, disconnection of ground power is initiated if the limits are not maintained. Protection against the following ground power supply faults is provided.

(1) Over-voltage.

(2) Under-voltage.

(3) Incorrect phase sequence.

(4) Under-frequency.

(5) Over-frequency.

(6) Open-phase.

(7) Feeder fault (Differential protection - in conjunction with differential protection current transformers).

Time delays are incorporated in the voltage and frequency protection circuits to prevent transient faults from causing nuisance disconnects. To assist trouble shooting, five bistable magnetic indicators are mounted on the front face of the unit to indicate the following faults:

(1) Over-voltage (OV).

(2) Under-voltage or open phase (UV).

(3) Incorrect frequency (IF).

(4) Incorrect phase sequence (PS).

(5) Differential faults (DP).

These indicators display either NORM or TRIP and, when in the 'tripped' condition, the TRIP display remains until reset by an adjacent RESET push switch that serves all indicators. The indicators cannot be reset without electrical power applied to the ground power protection unit. Buffer amplifiers between the indicators and the protection circuits prevent any fault in the indicator circuits, or fault indication, from affecting the sensing and control

capability of the unit.

D.C. power supplies are derived from the output of a three-phase transformer-rectifier which is energized by the ground power supply. The d.c. supplies are regulated for certain internal supply functions. One 28 V d.c. supply (unregulated) is used to provide a power source for the operation of external equipment, namely, the GPB, the ground power caption and indicator lights, the bus-tie breakers (BTBs) and split system breakers (SSBs) of the main a.c. generation system (Ref. 24-21-00) and the interphone system (Ref. 23-41-00). The circuits associated with this d.c. supply are protected by a circuit breaker on the front face of the unit.

3. Differential Protection Current Transformer (Ref. Fig. 002)

Two of these units are employed in the external power system to sense differential current in the ground supply feeder cables between the ground supply plug and the GPB. One unit is located on the right side of the nose landing gear bay near the ground supply plug, and the other unit is fitted near the GPB on the flight compartment right-hand racking electrical equipment panel 24-216. To assist correct orientation during installation, polarity of the transformers is indicated by the engraving T1 on one side and T2 on the other.

The two units are identical and each contains three current transformers. Each phase of the feeders passes through the secondary windings of two transformers, one in each unit, to act as a single primary conductor, the voltages induced in the primaries being proportional to feeder current. The secondaries of each transformer pair are connected in a loop circuit so that no voltages are induced in the loops when the same current flows in both primaries. A feeder fault between transformer pairs, however, unbalances the loop current and the resulting output voltage causes the operation of the differential current monitor in the ground power protection unit.

4. Ground Power Breaker (GPB) (Ref. Fig. 002)

The GPB is an electromagnetic contactor fitted on the flight compartment right-hand racking electrical equipment panel 24-216 and interposed in the circuit between the ground supply plug and the two split system breakers (SSBs). The GPB connects the external supply to the busbars of the main a.c. distribution system (via the SSBs) when GPB 'close' logic is satisfied, and disconnects the supply when 'trip' is demanded

(Ref. Fig. 005).

Auxiliary contacts of the GPB form part of the main a.c. generation generator circuit breaker (GCB) control logic and prevent paralleling of main and external power, if the GPB fails to open when 'trip' is demanded (Ref. 24-21-00). Other auxiliary contacts of the GPB form part of the control circuit of the 'ground power not in use' indicator light.

**ON A/C 001-005,

Further auxiliary contacts of the GPB are associated with the following systems:

(1) Interphone (Ref. 23-41-00).

(2) Flight Data Recording (Ref. 31-31-00).

(3) Hydraulic Ground Pressurizing System (Ref. 29-23-00).

(4) Air Extraction (Ref. 21-21-00).

**ON A/C 001-005,

5. Ground Supply Plug (Ref. Fig. 002)

The ground supply plug enables an external power supply to be coupled to the aircraft by an associated connector on the external supply cable. Four pins in the plug connect the three-phase external supply and its neutral return. Two additional smaller and shorter pins connect the d.c. control circuit for a safety and hold-on circuit incorporated in the external power supply rig.

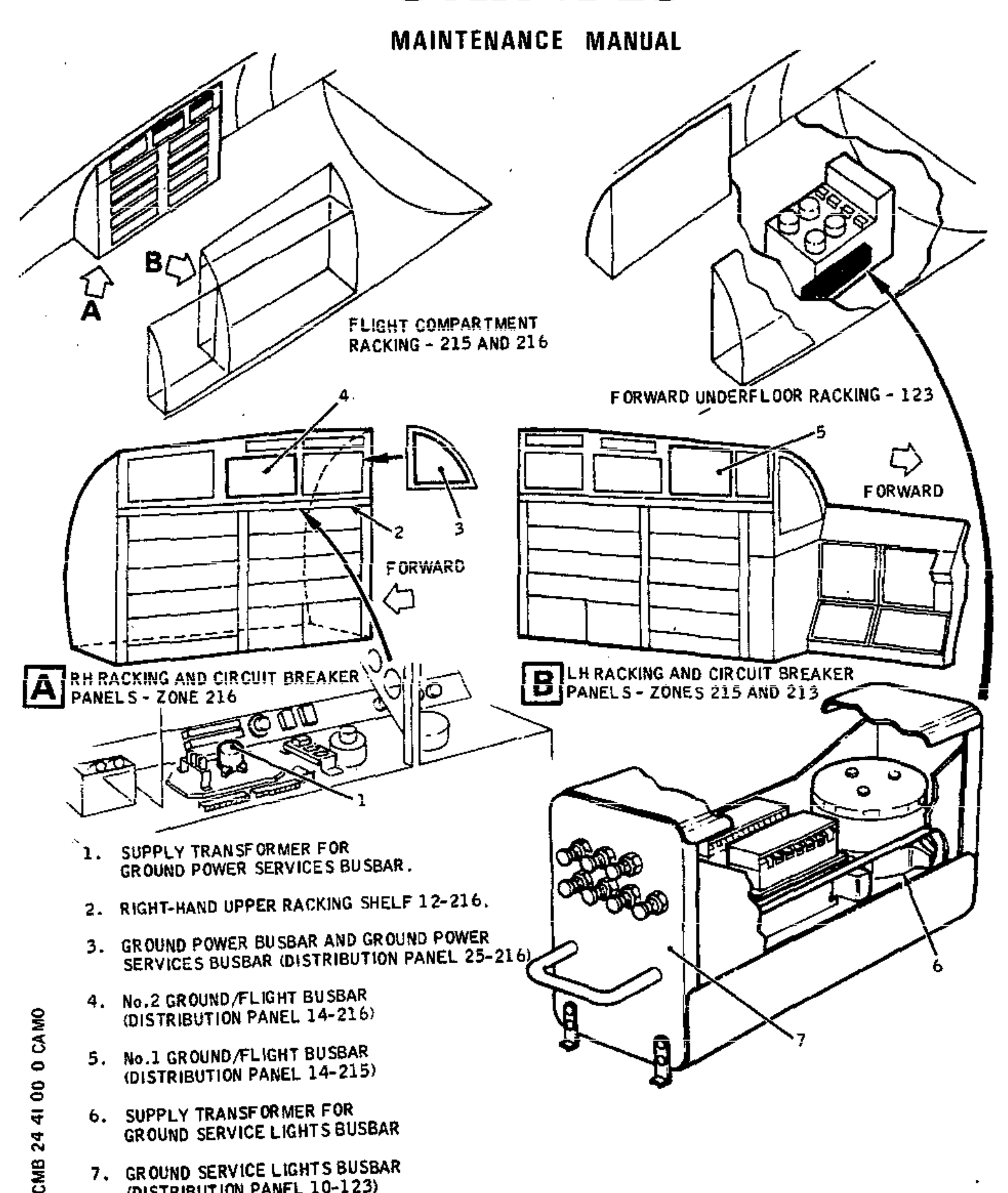
Access to the plug is gained by opening the ground supply plug access panel. The aircraft electrical cable connections to the plug are located beneath a cover accessible from inside the nose landing gear bay.

6. Ground Services Distribution Equipment (Ref. Fig.003 and 004)

A. Ground Power Busbar, 200/115 V Three-phase AC

This is the primary supply busbar of the ground services distribution system and is situated with its distribution circuit breakers at panel 25-216 in the flight compartment right-hand racking.

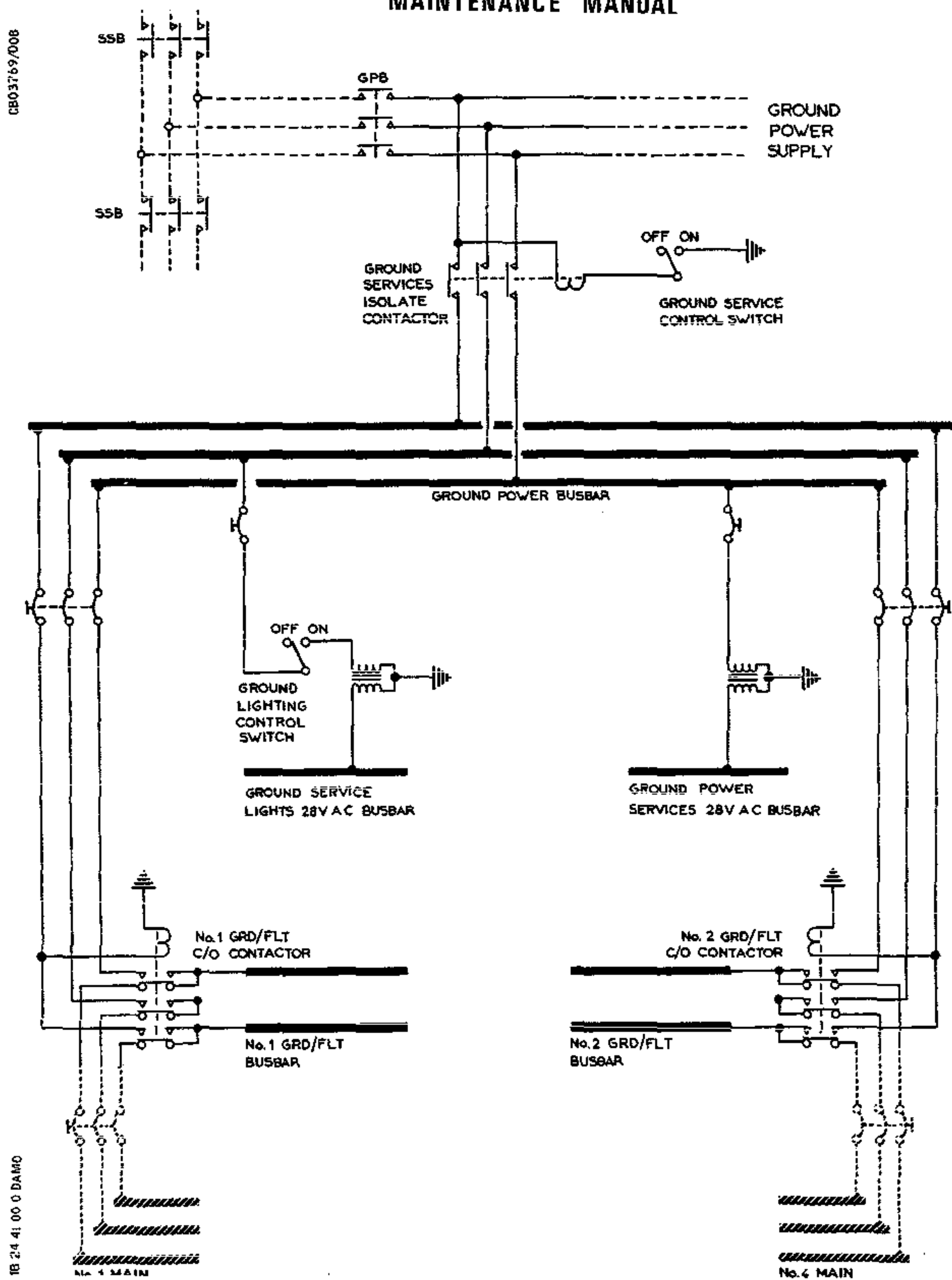
B. Ground Services Isolate Contactor



1. SUPPLY TRANSFORMER FOR GROUND POWER SERVICES BUSBAR.
2. RIGHT-HAND UPPER RACKING SHELF 12-216.
3. GROUND POWER BUSBAR AND GROUND POWER SERVICES BUSBAR (DISTRIBUTION PANEL 25-216)
4. No.2 GROUND/FLIGHT BUSBAR (DISTRIBUTION PANEL 14-216)
5. No.1 GROUND/FLIGHT BUSBAR (DISTRIBUTION PANEL 14-215)
6. SUPPLY TRANSFORMER FOR GROUND SERVICE LIGHTS BUSBAR
7. GROUND SERVICE LIGHTS BUSBAR (DISTRIBUTION PANEL 10-123)

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Ground Services Equipment
Figure 003



- Ground Services Control - Simplified Schematic
Figure 004

This contactor is fitted on the flight compartment right-hand racking equipment panel 26-216 and is interposed in the circuit between the ground supply plug and the ground power busbar. The contactor is closed and the ground power busbar therefore 'live' whenever ground power is coupled to the aircraft and the ground service switch on the steward's panel in the forward vestibule is set to 'on'. Auxiliary contacts of the contactor form part of the control circuit of the 'ground power not in use' indicator light.

C. Ground Power Services Busbar, 28 V Single-phase AC

This busbar with its distribution circuit breakers is situated at panel 25-216 in the flight compartment right-hand racking and is supplied by a 115/28 V 400 Hz single-phase a.c. transformer fitted on the equipment panel 12-216 in the same racking. The transformer input is taken from phase C of the ground power busbar and the ground power services busbar is therefore 'live' whenever the ground power busbar is 'live'.

D. Ground Service Lights Busbar, 28 V Single-phase AC

This busbar with its distribution circuit breakers and a 115/28 V 400 Hz single-phase a.c. supply transformer are situated in the underfloor racking panel 10-123. The transformer input is taken from phase B of the ground power busbar; the ground service lights busbar is therefore 'live' whenever the ground power busbar is 'live', provided that a ground lighting control switch, interposed in the transformer input circuit, is in the 'on' position.

E. Nos.1 and 2 Ground/Flight Busbars, 200/115 V Three-phase AC

No.1 ground/flight busbar, with its distribution circuit breakers, is situated at the flight compartment left-hand racking panel 14-215. An associated No.1 ground/flight change-over contactor is fitted on the equipment panel 12-215 in the same racking.

No.2 ground/flight busbar, with its distribution circuit breakers, is situated at the flight compartment right-hand racking panel 14-216. An associated No.2 ground/flight change-over contactor is fitted on the equipment panel 12-216 in the same racking.

Nos.1 and 2 ground/flight busbars are normally connected to Nos.1 and 4 main busbars respectively (Ref. 24-51-00)

by Nos.1 and 2 ground/flight change-over contactors. These contactors are connected so that both Nos.1 and 2 ground/flight busbars are automatically disconnected and reconnected to the ground power busbar whenever that busbar is 'live'. Auxiliary contacts of No.2 ground/flight change-over contactor are associated with the toilet lighting system (Ref. 33-22-00).

7. Operation

**ON A/C 001-005,

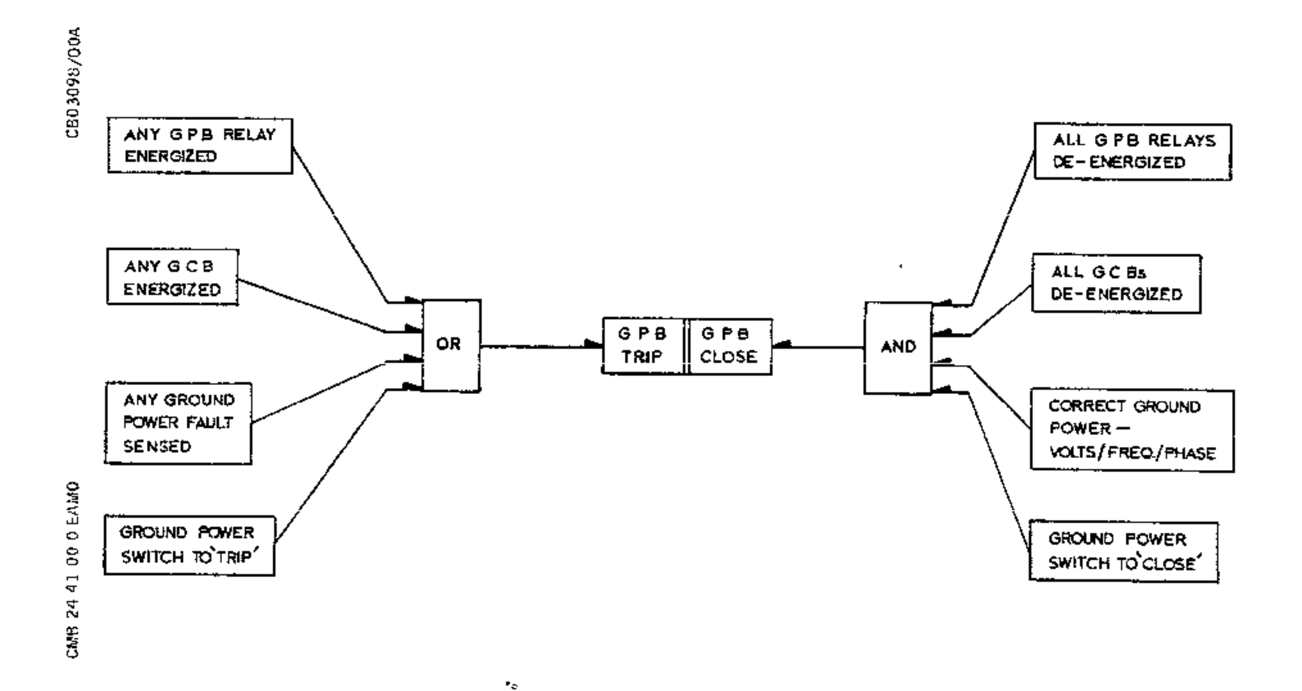
(Ref. Fig. 006)

**ON A/C 001-005,

(Ref. Fig.005 and 007)

**ON A/C 001-005,

**ON A/C 001-005,



GPB Control Logic
Figure 005

**ON A/C 001-005,

A. Control and Indication

Apart from the fault indicators and reset switch on the front face of the ground power protection unit, the function, location and identification of ground power controls and indicators is as follows:

Subject to the demands of GPB control logic, connection (or disconnection) of the ground power supply to (or from) the main a.c. distribution system is controlled by a three-position, spring return to centre-off toggle switch with CLOSE and TRIP at its extreme positions. This switch is fitted on the upper part of the main generating control panel. The adjacent caption light engraved GRND PWR AVAILABLE is illuminated and the indicator light in the ground supply plug compartment labelled GROUND POWER AVAILABLE is on whenever a ground supply of correct voltage, frequency and phase rotation is present at the ground supply plug.

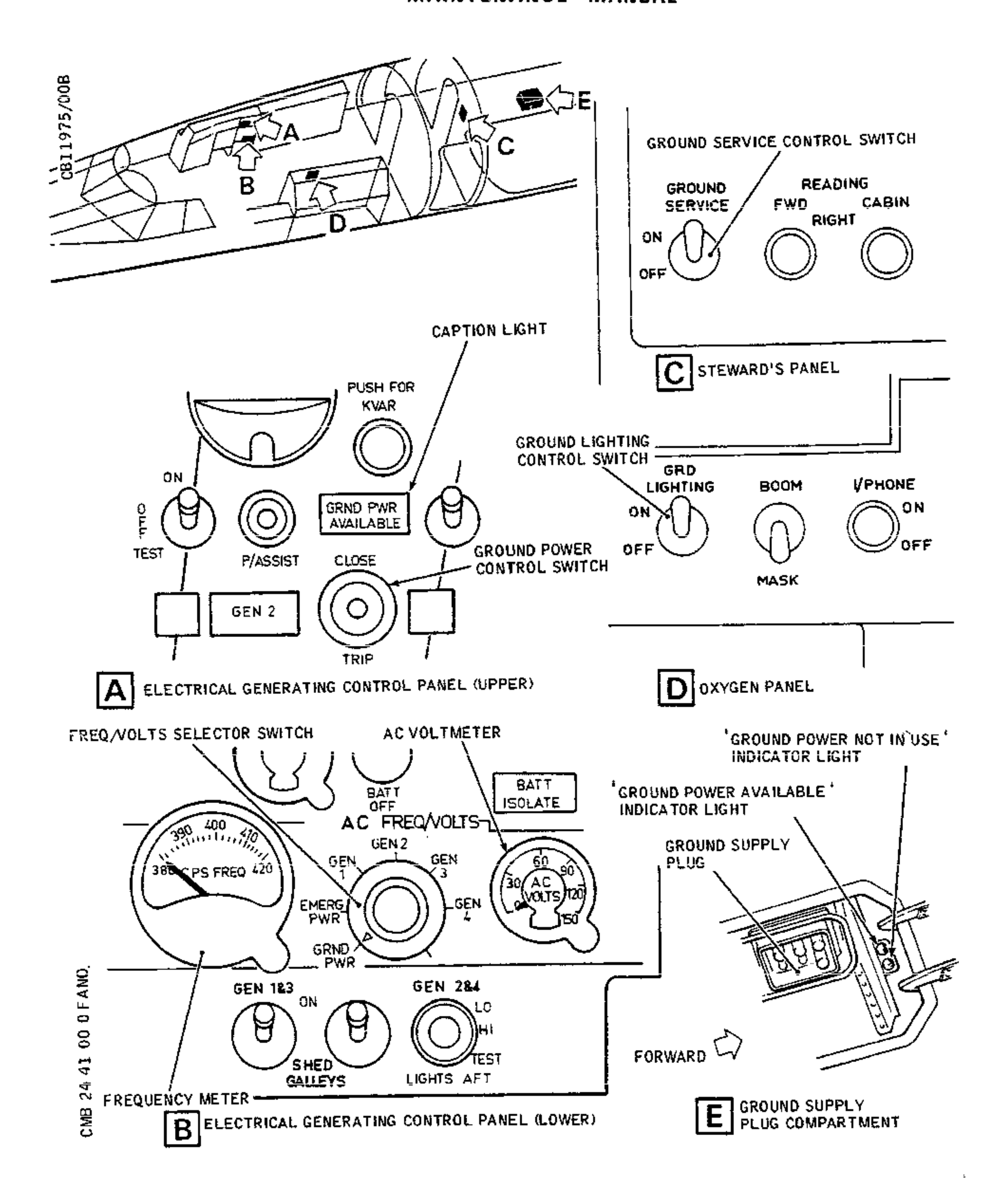
**ON A/C 001-005,

**ON A/C 001-005,

Connection (or disconnection) of the ground power supply to (or from) the ground services distribution system, through the ground services isolate contactor, is primarily controlled by a GROUND SERVICE toggle switch with ON and OFF positions. This switch is fitted on the steward's panel in the forward vestibule (panel 1-221).

On the lower part of the main generating control panel, the voltmeter and frequency meter that monitor the main and emergency generator outputs (Ref. 24-21-00 and 24-22-00) can be used also to monitor the ground power supply by selecting GRD PWR at the AC FREQ/VOLTS selector switch. By this action, the meters are connected to the phase A feeder cable from the ground supply plug and will indicate the voltage and frequency of the ground power supply both before and after closure of the GPB and/or the ground services isolate contactor.

The indicator light, labelled GROUND POWER NOT IN USE, in the ground supply plug compartment is controlled by the GPB and the ground services isolate contactor. It



Controls and Indicators
Figure 006

is lit when a satisfactory ground supply is present at the ground supply plug, but both the main a.c. distribution system and the ground services distribution system are isolated from the supply.

A GRD LIGHTING control toggle switch is fitted on the flight compartment left-hand racking panel 20-215 to provide on/off control of the power supply to the ground service lights 28 V a.c. busbar.

B. Functional Description (Ref. Fig. 007)

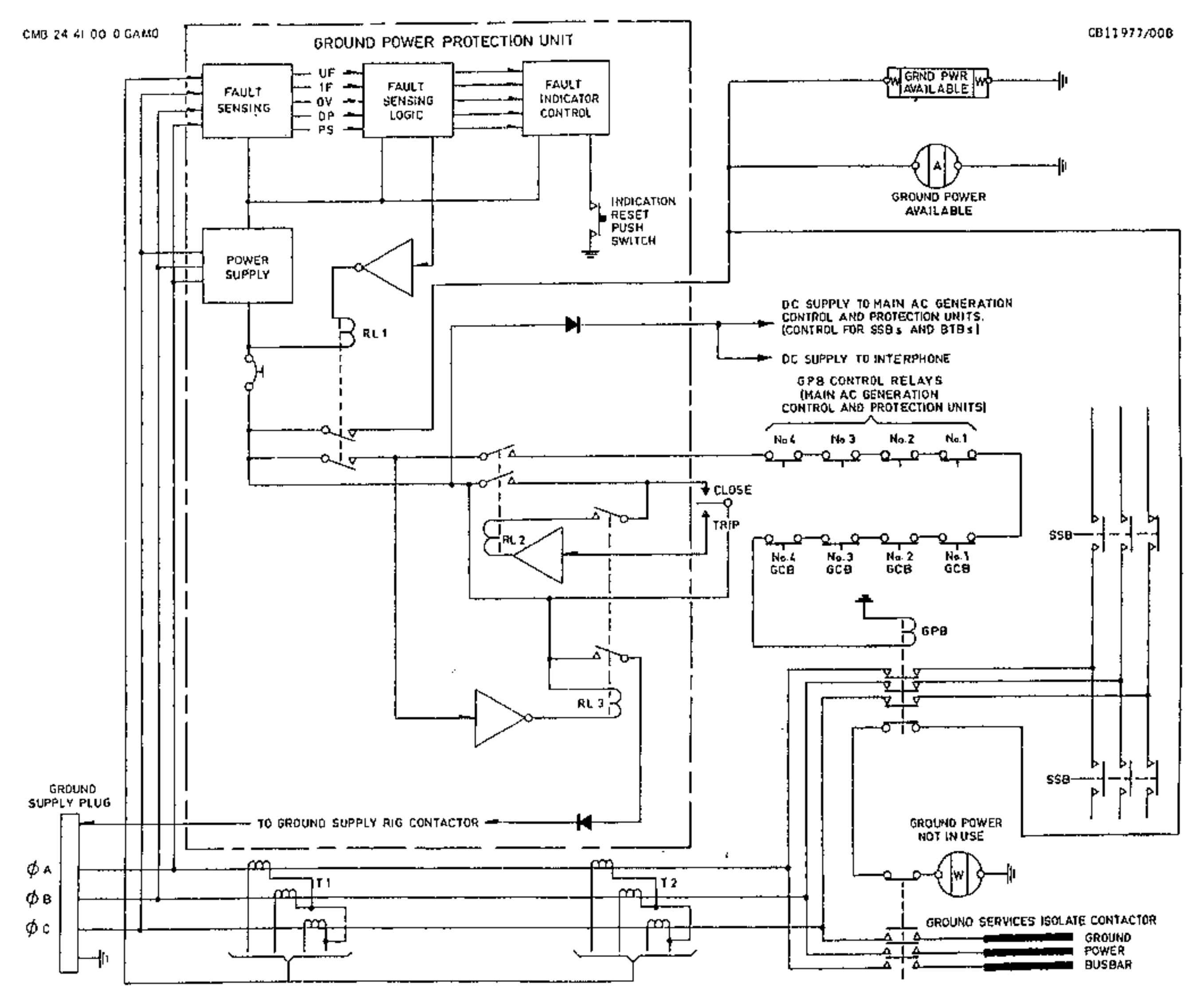
Whereas primary control of ground power is through the ground power control (CLOSE/TRIP) switch or the GROUND SERVICE control switch for particular distribution requirements, other automatic functions are necessary to establish ground power supply conditions and apply the required protection.

The function of the ground power protection unit and associated controls is as follows:

(1) A contactor in the external ground power supply rig is initially energized by a local (rig) 28 V d.c. supply when the control switch on the rig is operated. Three-phase power is thereby connected through the ground power supply plug and energizes the transformer-rectifier in the ground power protection unit so that power is applied to the unit fault sensing and logic control circuits, and a d.c. supply is available to energize the split system breakers (SSBs) and bus-tie breakers (BTBs) of the main a.c. generation system (Ref. 24-21-00). This d.c. supply also provides a power source for the interphone system while the GPB is open (Ref. 23-41-00).

(2) If the supply voltage, frequency and phase rotation are correct and no feeder fault exists, the final logic gate of the protection circuits applies a logic '1' to the amplifier controlling relay RL1, completing the earth return circuit and thereby causing relay RL1 to be energized. In consequence =

(a) one contact of relay RL1 connects a supply to illuminate the GRD PWR AVAILABLE caption, bring on the GROUND POWER AVAILABLE indicator light, and arm the control circuit of the GROUND POWER NOT IN USE indicator light for operation, and



- Ground Power Control - Simplified Schematic
Figure 007

(b) another contact of relay RL1 arms the control circuit of the GPB and also applies a signal to the control amplifier of relay RL3 thereby causing relay RL3 to be energized. In consequence -

b1) one contact of relay RL3 connects a 28 V 'hold-on' supply to the coil of the contactor in the ground supply rig in place of the local (rig) supply thereby maintaining connection of the power supply through the ground supply plug when the control switch on the supply rig is released, and

b2) another contact of relay RL3 arms relay RL2 which controls the operation of the GPB. Thus, if the ground services isolate contactor is closed (ground service control switch at ON) the power supply is connected to the ground services distribution system through the ground power busbar.

(3) Setting the ground power control switch momentarily to CLOSE causes relay RL2 to be energized by a supply via the arming contact of relay RL3, through RL2 coil and then to earth through RL2 amplifier. Thus operated, one contact of relay RL2 shunts the ground power control switch to latch itself 'on' and another completes the coil control circuit of the GPB previously armed by relay RL1. Provided then that no generator circuit breaker (GCB) in the main generation system is energized and no 'generator ready' signal is given by the control and protection unit (CPU) of any main generating channel (Ref. 24-21-00), the GPB closes to connect ground power to the main a.c. distribution system through the SSBs.

(4) Since the control circuits of both SSBs and all four BTBs are armed by the 28 V supply from the ground power protection unit, ground power can be connected to all a.c. busbars of the main a.c. distribution system by appropriate setting of the SSB and BTB control switches (SSB switches set to CLOSE, BTB switches at NORM). Phase sense monitoring is inhibited immediately RL2 is energized.

NOTE: If a BTB control switch is selected to TRIP while ground power is connected to the main

a.c. distribution system, the associated BTB is automatically re-energized when the switch is returned to NORM. The RESET position of the BTB control switch is associated with fault protection circuits effective during operation of the main a.c. generation system (Ref. 24-21-00).

If a low pressure condition is detected in the equipment bay cooling system while the ground supply is connected to the main a.c. distribution system, the ground call horn will sound to indicate that the GPB must be tripped and the cause investigated (Ref. 21-21-00).

(5) Setting the ground power control switch momentarily to TRIP connects a positive signal to the input of the control amplifier of relay RL2. This signal is inverted to 'switch-off' the amplifier, thereby effectively removing the earth return circuit and so de-energizing and unlatching relay RL2. The GPB is de-energized and ground power thereby disconnected from the main a.c. distribution system but, since relays RL1 and RL3 remain energized, the GRD PWR AVAILABLE caption remains illuminated, the GROUND POWER AVAILABLE indicator lamp remains on and the ground supply is available to power the ground services distribution system and/or the main a.c. distribution system as required.

(6) If a power malfunction is sensed, the output from the final logic gate of the protection circuits applies a logic '0' to the amplifier controlling relay RL1. In consequence, relays RL1, RL2 and RL3 are all de-energized. The GPB and the contactor in the ground power supply rig are then de-energized, the GRD PWR AVAILABLE caption is extinguished, the GROUND POWER AVAILABLE indicator light goes out and the ground power supply is isolated from the aircraft ground supply feeder cables and hence from all aircraft busbars.

(7) If ground power is faulty on initial connection, the monitoring circuits prevent relay RL1 from becoming energized. Thus, connection of a faulty ground power supply to the main a.c. distribution system is prevented and disconnection of such a supply from the aircraft ground supply feeder cables, and so from the ground services distribution system, is immediate on release of the control switch on the

ground supply rig.

(8) Normally-closed contacts of four GCB control relays, one in each main generation CPU (Ref. 24-21-00), are series-connected in the GPB coil circuit. The GPB control relay in any main generating channel is energized when the voltage and frequency of that channel are within predetermined limits. Thus, as a main engine is started, the GPB is automatically de-energized to disconnect ground power from the main a.c. distribution system when the associated main generator attains the specified voltage and frequency. The TEST facility for main generators (Ref. 24-21-00) inhibits this function and prevents the associated generator from coming on-line.

(9) Normally-closed auxiliary contacts of the four GCBs in the main generation system are series-connected in the GPB coil circuit. This prevents the GPB from closing if any main generator is supplying power to the main a.c. distribution system.

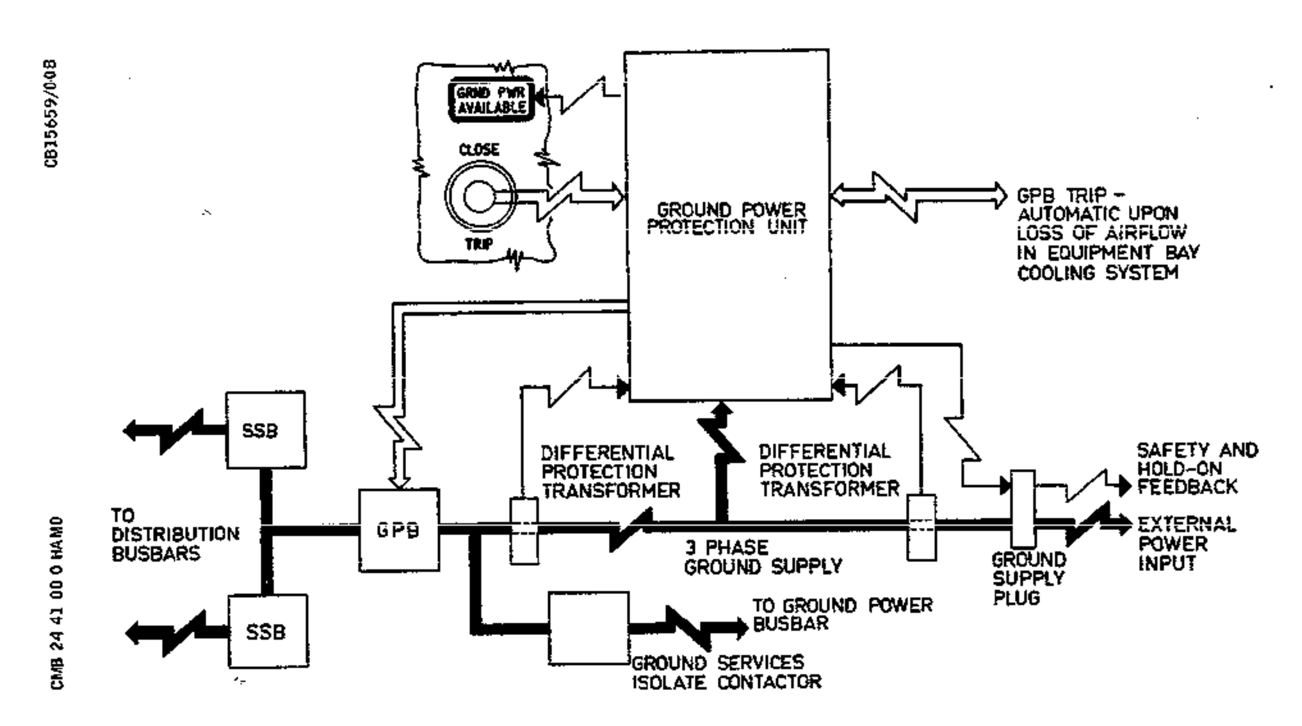
R **ON A/C 006-007,

EXTERNAL POWER - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 001)

200/115 V three-phase 400 Hz a.c. external ground power can be used to supply the main a.c. distribution system (and hence the essential a.c. and the d.c. distribution systems) for aircraft ground servicing and testing or to supply a separate ground services distribution system to provide power for selected ground services only. Ground power is coupled to the aircraft through a ground supply plug situated in a compartment behind an access panel on the right underside of the fuselage approximately 2 ft (0.61 m) rearward from the front face of the nose landing gear bay. To prevent drag on the coupling, the supply plug compartment houses a hinged stirrup (hook) for use with an associated device on the ground power cable.

R **ON A/C 006-007,



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Ground Power
Figure 001

A ground power breaker (GPB) connects the ground supply to the busbars of the main a.c. distribution system and is controlled primarily by a ground power control switch at the third crew member's station. A ground services isolate contactor connects the ground supply to a ground power busbar and is controlled by a ground service control switch on the steward's panel in the forward vestibule. The ground power busbar is the primary supply busbar of the ground services distribution system. This system enables ground power to be distributed to certain circuits, e.g., lighting, refuelling, etc., without further connection of the supply to the main a.c. distribution system through the GPB. Three-phase power supplies for the ground hydraulic check-out electric pumps (Ref. 29-23-00) are taken direct from the ground supply plug.

Protection is provided to prevent connection of ground power to the main a.c. distribution system and/or the ground services distribution system if the ground power supply does not meet specific standards of frequency, voltage and phase rotation and, after connection, to disconnect the supply if the standards are not maintained.

In addition, the aircraft ground power feeder cables are protected so that similar results are produced if a feeder fault is sensed. Protection is also provided to prevent paralleling of main-generated and ground power.

Indication that a satisfactory external supply is present at the ground supply plug, i.e., 'ground power available' is given by a caption light at the third crew member's station and by an amber indicator light in the power supply plug compartment. A second (white) indicator light in the latter position is provided to indicate 'ground power not in use'.

It is important to note that before ground power is connected to the main a.c. distribution system, the equipment bay cooling controls must be set for the normal ground state and that, subject to individual test requirements, distribution circuit breakers identified with a coloured surround must be tripped (Ref. Servicing).

R

If equipment bay cooling failure (inadequate airflow in an extraction duct) is sensed after closure of the GPB, the ground call horn will be switched on to give immediate warning of the failure (Ref. 21-21-00) and the GPB will be tripped automatically after a time delay of 45 s. This inhibition of ground power can be overridden to facilitate the rectification of equipment bay cooling faults; the override facility is provided by a toggle switch located behind circuit breaker panel 15-216 in the flight

compartment right-hand racking.

2. Ground Power Protection Unit (Ref. Fig. 002)

This unit is contained within a 1/4 ATR short case and is located on shelf 1-216 in the flight compartment right-hand racking. The unit senses the incoming ground power supply and prevents connection of ground power to the main a.c. distribution system and/or the ground services distribution system if the ground supply characteristics are outside specified limits.

In addition, disconnection of ground power is initiated if the limits are not maintained. Protection against the following ground power supply faults is provided.

(1) Over-voltage.

(2) Under-voltage.

(3) Incorrect phase sequence.

(4) Under-frequency.

(5) Over-frequency.

(6) Open-phase.

(7) Feeder fault (Differential protection - in conjunction with differential protection current transformers).

Time delays are incorporated in the voltage and frequency protection circuits to prevent transient faults from causing nuisance disconnects. To assist trouble shooting, five bistable magnetic indicators are mounted on the front face of the unit to indicate the following faults:

(1) Over-voltage (OV).

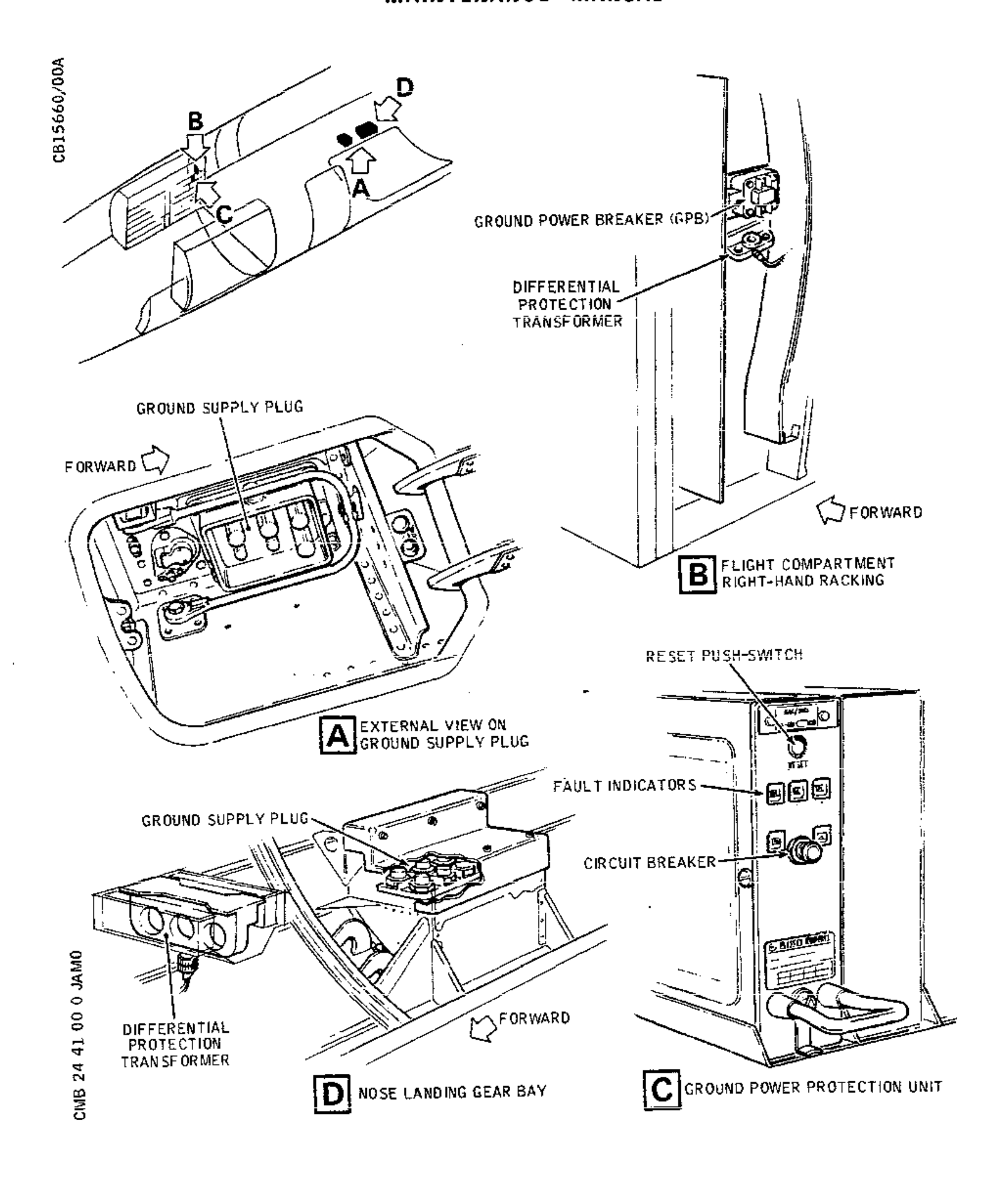
(2) Under-voltage or open phase (UV).

(3) Incorrect frequency (IF).

(4) Incorrect phase sequence (PS).

(5) Differential faults (DP).

These indicators display either NORM or TRIP and, when in the 'tripped' condition, the TRIP display remains until reset by an adjacent RESET push switch that serves all indicators. The indicators cannot be reset without



Ground Power Equipment
Figure 002

electrical power applied to the ground power protection unit. Buffer amplifiers between the indicators and the protection circuits prevent any fault in the indicator circuits, or fault indication, from affecting the sensing and control capability of the unit.

D.C. power supplies are derived from the output of a three-phase transformer-rectifier which is energized by the ground power supply. The d.c. supplies are regulated for certain internal supply functions. One 28 V d.c. supply (unregulated) is used to provide a power source for the operation of external equipment, namely, the GPB, the ground power caption and indicator lights, the bus-tie breakers (BTBs) and split system breakers (SSBs) of the main a.c. generation system (Ref. 24-21-00) and the interphone system (Ref. 23-41-00). The circuits associated with this d.c. supply are protected by a circuit breaker on the front face of the unit.

3. Differential Protection Current Transformer (Ref. Fig. 002)

Two of these units are employed in the external power system to sense differential current in the ground supply feeder cables between the ground supply plug and the GPB. One unit is located on the right side of the nose landing gear bay near the ground supply plug, and the other unit is fitted near the GPB on the flight compartment right-hand racking electrical equipment panel 24-216. To assist correct orientation during installation, polarity of the transformers is indicated by the engraving T1 on one side and T2 on the other.

The two units are identical and each contains three current transformers. Each phase of the feeders passes through the secondary windings of two transformers, one in each unit, to act as a single primary conductor, the voltages induced in the primaries being proportional to feeder current. The secondaries of each transformer pair are connected in a loop circuit so that no voltages are induced in the loops when the same current flows in both primaries. A feeder fault between transformer pairs, however, unbalances the loop current and the resulting output voltage causes the operation of the differential current monitor in the ground power protection unit.

4. Ground Power Breaker (GPB) (Ref. Fig. 002)

The GPB is an electromagnetic contactor fitted on the flight compartment right-hand racking electrical equipment panel 24-216 and interposed in the circuit between the ground supply plug and the two split system

breakers (SSBs). The GPB connects the external supply to the busbars of the main a.c. distribution system (via the SSBs) when GPB 'close' logic is satisfied, and disconnects the supply when 'trip' is demanded (Ref. Fig. 005).

Auxiliary contacts of the GPB form part of the main a.c. generation generator circuit breaker (GCB) control logic and prevent paralleling of main and external power, if the GPB fails to open when 'trip' is demanded (Ref. 24-21-00). Other auxiliary contacts of the GPB form part of the control circuit of the 'ground power not in use' indicator light.

R **ON A/C 007-007,

Further auxiliary contacts of the GPB are associated with the following systems:

(1) Interphone (Ref. 23-41-00).

(2) Flight Data Recording (Ref. 31-31-00).

(3) Hydraulic Ground Pressurizing System (Ref. 29-23-00).

(4) Buffet/Galley (Ref. 25-30-00).

(5) Air Extraction (Ref. 21-21-00).

R **ON A/C 006-006,

R Further auxiliary contacts of the GPB are associated
R with the following systems:

R (1) Interphone (Ref. 23-41-00).

R (2) Flight Data Recording (Ref. 31-31-00).

R (3) Hydraulic Ground Pressurizing System (Ref. 29-23-00).

R (4) Air Extraction (Ref. 21-21-00).

R **ON A/C 006-007,

5. <u>Ground Supply Plug</u> (Ref. Fig. 002)

The ground supply plug enables an external power supply to be coupled to the aircraft by an associated connector on the external supply cable. Four pins in the plug connect the three-phase external supply and its neutral return. Two additional smaller and shorter pins connect the d.c. control

circuit for a safety and hold-on circuit incorporated in the external power supply rig.

Access to the plug is gained by opening the ground supply plug access panel. The aircraft electrical cable connections to the plug are located beneath a cover accessible from inside the nose landing gear bay.

R

6. Ground Power Control Relay

The ground power control relay is fitted on panel 7-123 in the forward underfloor racking. It has an integral time delay on closure of 45 s.

If an equipment bay cooling fault, i.e., inadequate airflow in an extraction duct (Ref. 21-21-00), is sensed after closure of the GPB, the ground power relay automatically trips the GPB after the time delay of 45 s.

7. Ground Services Distribution Equipment (Ref. Fig.003 and 004)

A. Ground Power Busbar, 200/115 V Three-phase AC

This is the primary supply busbar of the ground services distribution system and is situated with its distribution circuit breakers at panel 25-216 in the flight compartment right-hand racking.

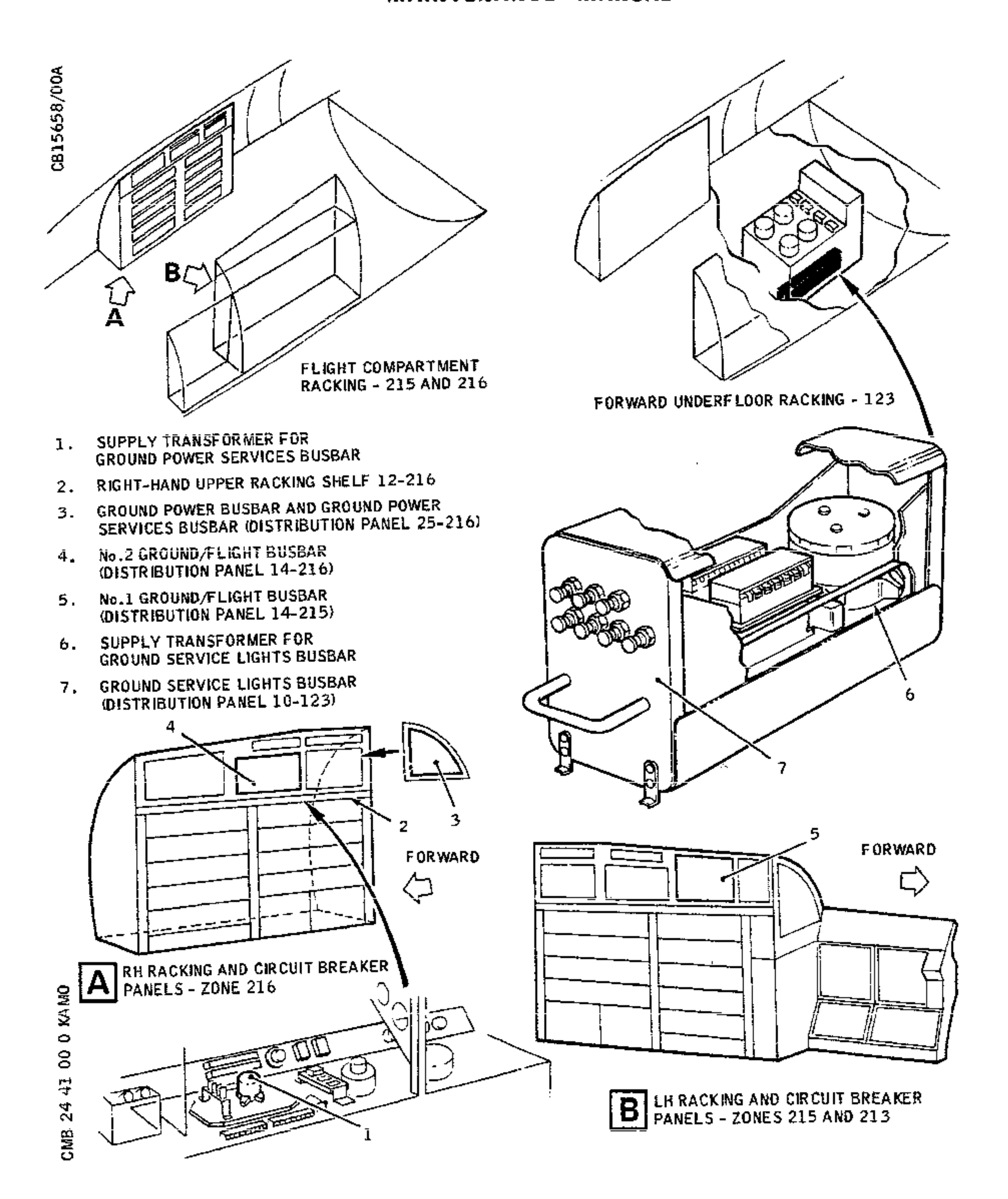
B. Ground Services Isolate Contactor

This contactor is fitted on the flight compartment right-hand racking equipment panel 26-216 and is interposed in the circuit between the ground supply plug and the ground power busbar. The contactor is closed and the ground power busbar therefore 'live' whenever ground power is coupled to the aircraft and the ground service switch on the steward's panel in the forward vestibule is set to 'on'. Auxiliary contacts of the contactor form part of the control circuit of the 'ground power not in use' indicator light.

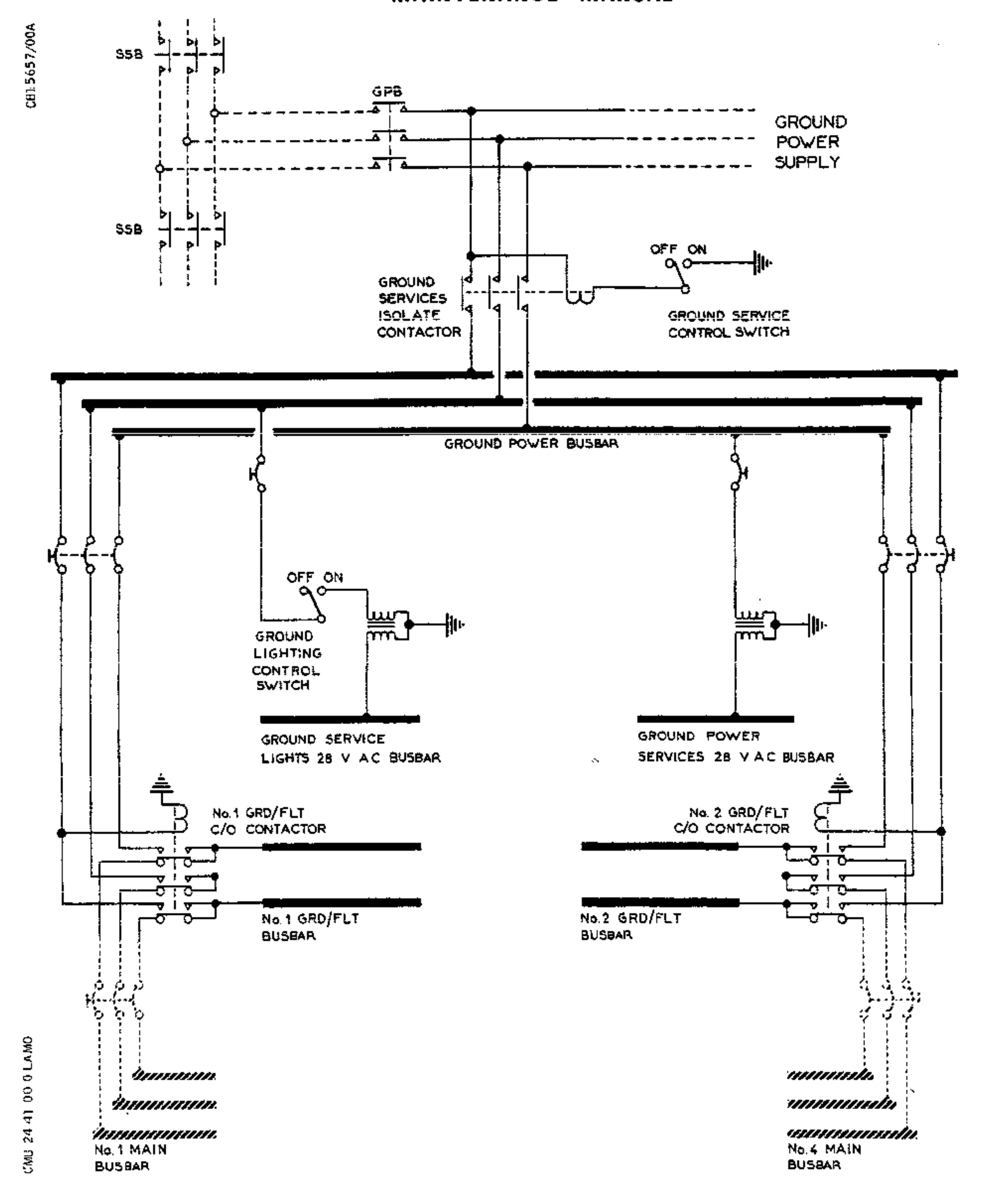
R **ON A/C 006-007,

C. Ground Power Services Busbar, 28 V Single-phase AC

This busbar with its distribution circuit breakers is situated at panel 25-216 in the flight compartment right-hand racking and is supplied by a 115/28 V 400 Hz single-phase a.c. transformer fitted on the equipment panel 12-216 in the same racking. The transformer input is taken from phase C of the ground power busbar and the



Ground Services Equipment
Figure 003



- Ground Services Control - Simplified Schematic
Figure 004

ground power services busbar is therefore 'live' whenever the ground power busbar is 'live'.

D. Ground Service Lights Busbar, 28 V Single-phase AC

This busbar with its distribution circuit breakers and a 115/28 V 400 Hz single-phase a.c. supply transformer are situated in the underfloor racking panel 10-123. The transformer input is taken from phase B of the ground power busbar; the ground service lights busbar is therefore 'live' whenever the ground power busbar is 'live', provided that a ground lighting control switch, interposed in the transformer input circuit, is in the 'on' position.

E. Nos.1 and 2 Ground/Flight Busbars, 200/115 V Three-phase AC

No.1 ground/flight busbar, with its distribution circuit breakers, is situated at the flight compartment left-hand racking panel 14-215. An associated No.1 ground/flight change-over contactor is fitted on the equipment panel 12-215 in the same racking.

No.2 ground/flight busbar, with its distribution circuit breakers, is situated at the flight compartment right-hand racking panel 14-216. An associated No.2 ground/flight change-over contactor is fitted on the equipment panel 12-216 in the same racking.

Nos.1 and 2 ground/flight busbars are normally connected to Nos.1 and 4 main busbars respectively (Ref. 24-51-00) by Nos.1 and 2 ground/flight change-over contactors. These contactors are connected so that both Nos.1 and 2 ground/flight busbars are automatically disconnected and reconnected to the ground power busbar whenever that busbar is 'live'. Auxiliary contacts of No.2 ground/flight change-over contactor are associated with the toilet lighting system (Ref. 33-22-00).

8. <u>Operation</u> (Ref. Fig. 005)

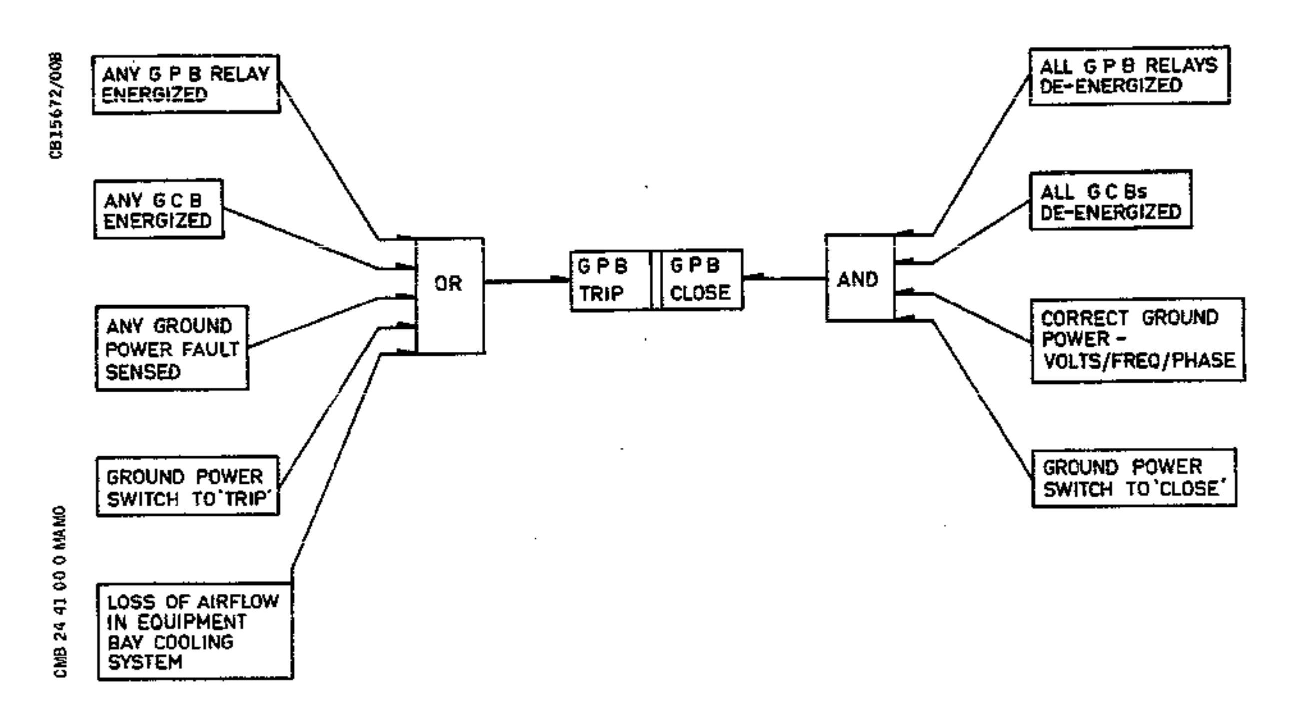
R **ON A/C 007-007,
(Ref. Fig.006 and 008)

R **ON A/C 006-006,
(Ref. Fig.007 and 008)

R **ON A/C 006-007,

A. Control and Indication

R **ON A/C 006-007,



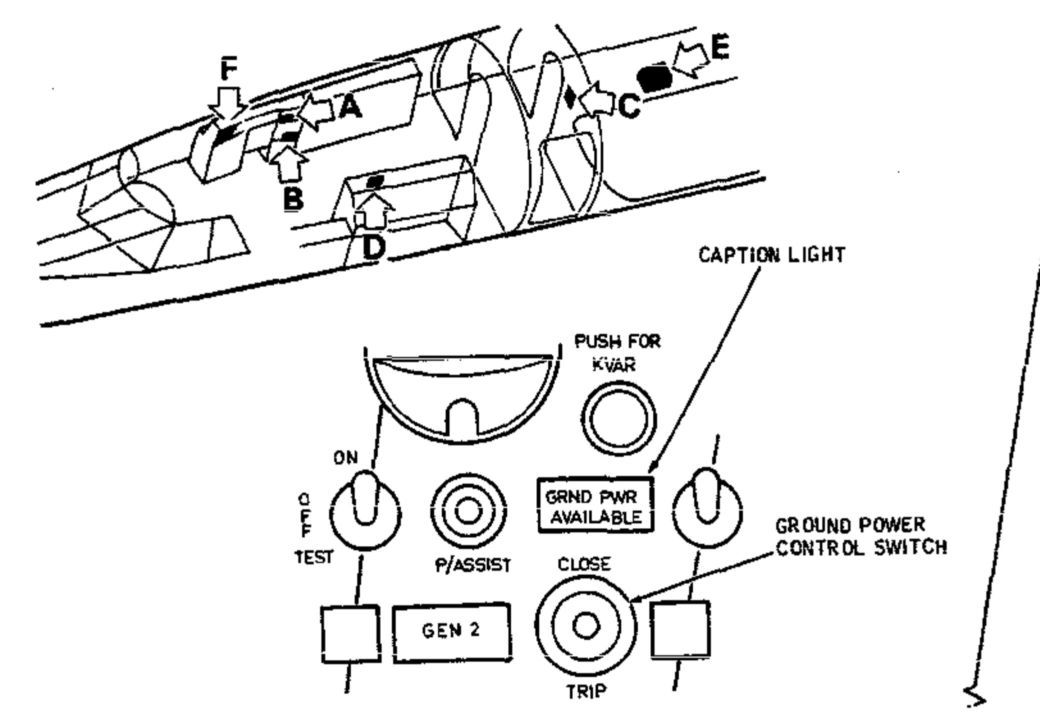
R GPB Control Logic
Figure 005

Apart from the fault indicators and reset switch on the front face of the ground power protection unit, the function, location and identification of ground power controls and indicators is as follows:

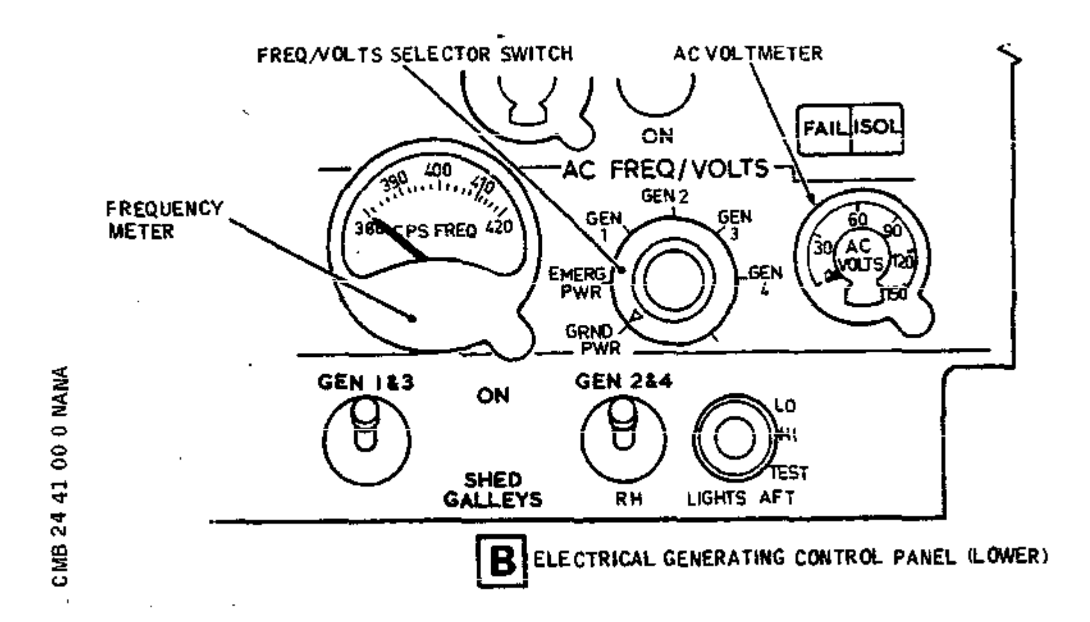
Subject to the demands of GPB control logic, connection (or disconnection) of the ground power supply to (or from) the main a.c. distribution system is controlled by a three-position, spring return to centre-off toggle switch with CLOSE and TRIP at its extreme positions. This switch is fitted on the upper part of the main generating control panel. The adjacent caption light engraved GRND PWR AVAILABLE is illuminated and the indicator light in the ground supply plug compartment labelled GROUND POWER AVAILABLE is on whenever a ground supply of correct voltage, frequency and phase rotation is present at the ground supply plug.

R

The control circuit which effects automatic tripping

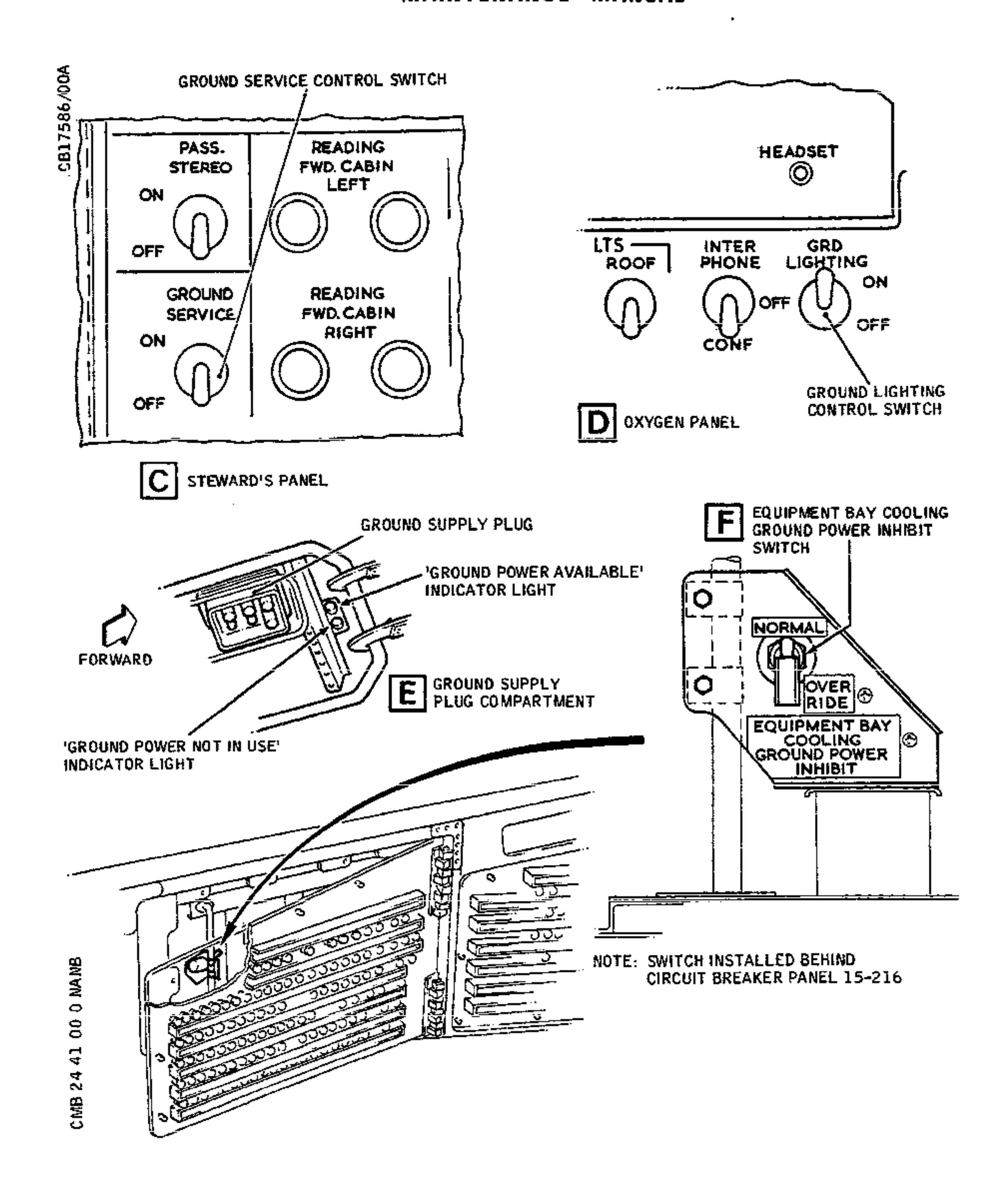


A ELECTRICAL GENERATING CONTROL PANEL (UPPER)

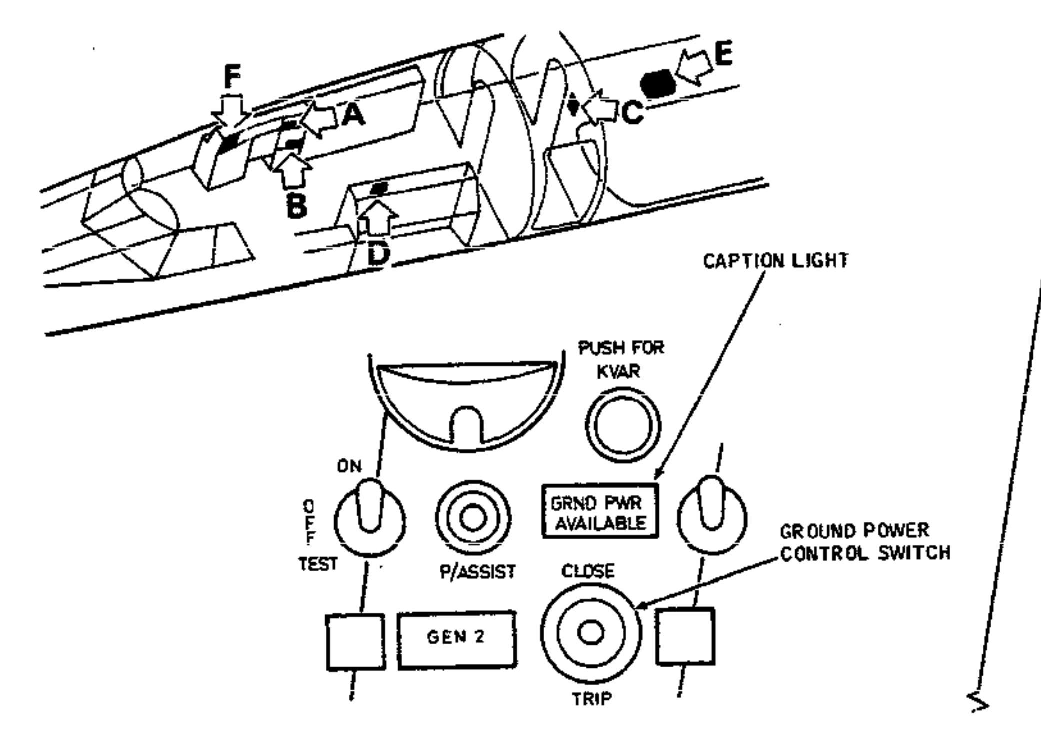


B ELECTRICAL GENERATING CONTROL PANEL (LOWER)

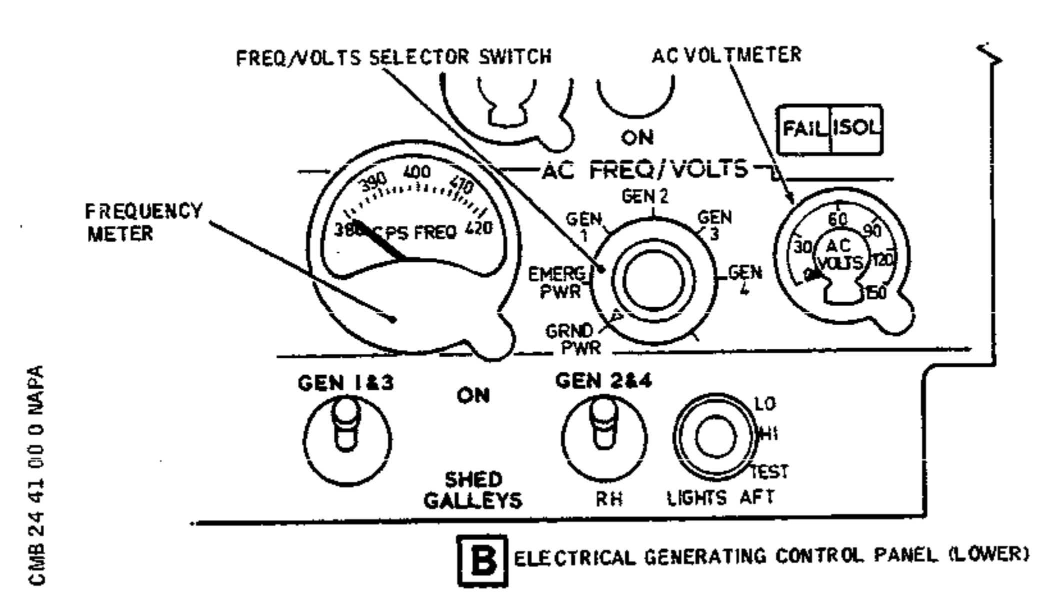
R - Controls and Indicators (Sheet 1 of 2)
Figure 006



R Controls and Indicators (Sheet 2 of 2)
Figure 006



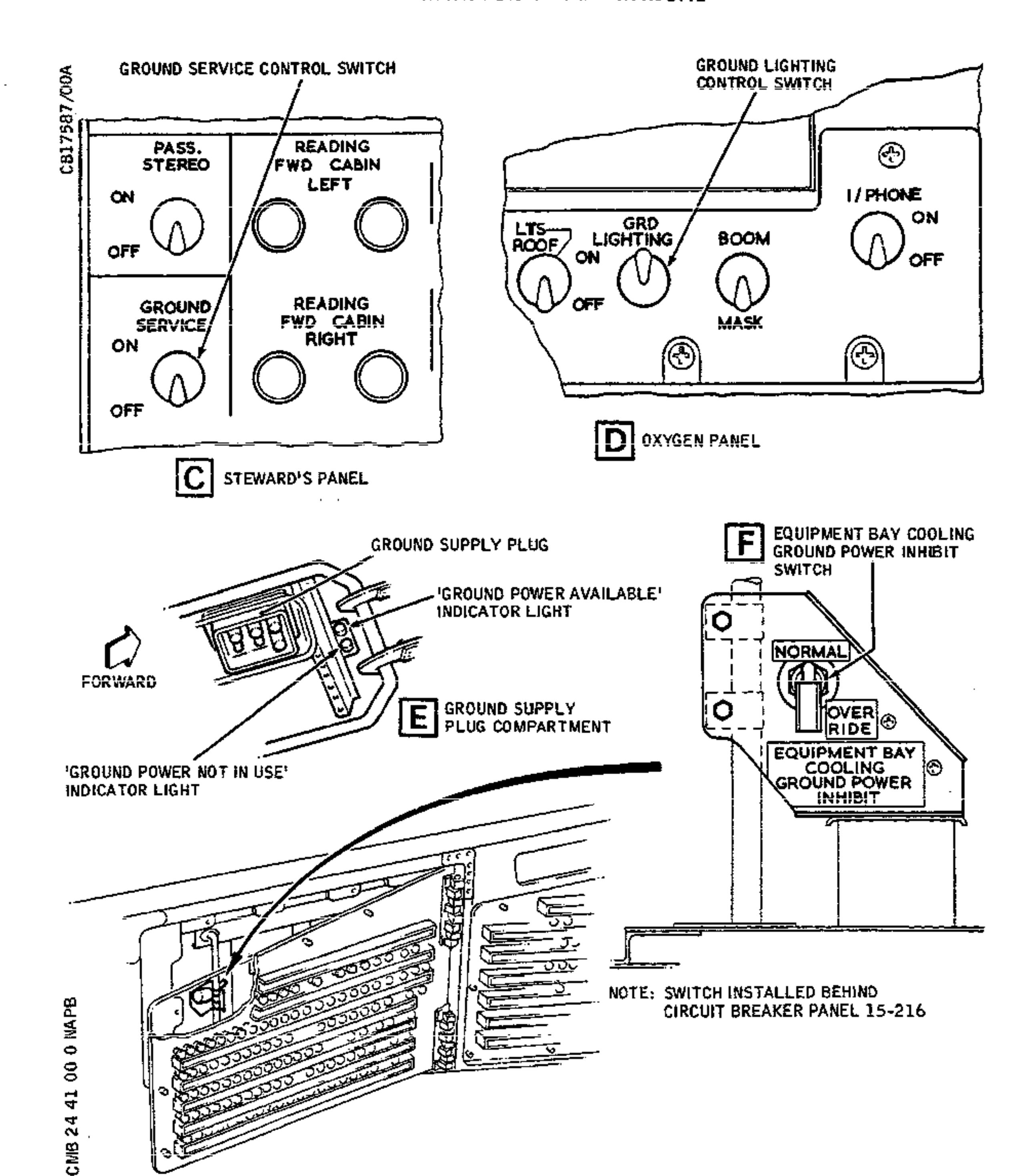
A ELECTRICAL GENERATING CONTROL PANEL (UPPER)



B ELECTRICAL GENERATING CONTROL PANEL (LOWER)

Controls and Indicators (Sheet 1 of 2)
Figure 007

R



- Controls and Indicators (Sheet 2 of 2)
Figure 007

R

of the GPB, in the event of the equipment bay cooling failure, includes the ground power control relay with its 45 s time delay, auxiliary contacts of the GPB, contacts of the forward and rear extraction duct pressure switches (Ref. 21-21-00) and a toggle switch labelled EQUIPMENT BAY COOLING GROUND POWER INHIBIT.

The EQUIPMENT BAY COOLING GROUND POWER INHIBIT toggle switch is located behind circuit breaker panel 15-216 in the flight compartment right-hand racking. It is fitted with a guard which is drilled for tie locking. The switch has two positions, NORMAL and OVERRIDE, which are effective as follows:-

(1) NORMAL: Guarded. If an equipment bay cooling fault (inadequate airflow in an extraction duct) is sensed after closure of the GPB, the ground call horn will sound to give immediate warning of the failure, and the ground power control relay will be energized to trip the GPB after a time delay of 45 s.

(2) OVERRIDE: Solenoid-held position: spring-return to NORMAL. Setting to the OVERRIDE position is effective when -

(a) the setting is made within a period of 45 s after the GPB has closed, and

(b) an equipment bay cooling fault causing previous tripping of the GPB has not been cleared, i.e., the contacts of an extraction duct pressure switch remain closed.

When the switch is set to OVERRIDE under the conditions given in paragraphs (2)(a) and (b), above, an internal solenoid is energized to hold the switch in the OVERRIDE position. While the switch is held in this position, the coil control supply of the ground power control relay is interrupted and further tripping of the GPB by the equipment bay cooling fault is prevented. When the fault is cleared or the GPB is tripped, the internal solenoid is de-energized and the switch returns automatically to the NORMAL position.

Connection (or disconnection) of the ground power supply to (or from) the ground services distribution system,

through the ground services isolate contactor, is primarily controlled by a GROUND SERVICE switch with ON and OFF positions. This switch is fitted on the steward's panel in the forward vestibule (panel 1-221).

R **ON A/C 006-007,

On the lower part of the main generating control panel, the voltmeter and frequency meter that monitor the main and emergency generator outputs (Ref. 24-21-00 and 24-22-00) can be used also to monitor the ground power supply by selecting GRD PWR at the AC FREQ/VOLTS selector switch. By this action, the meters are connected to the phase A feeder cable from the ground supply plug and will indicate the voltage and frequency of the ground power supply both before and after closure of the GPB and/or the ground services isolate contactor.

The indicator light, labelled GROUND POWER NOT IN USE, in the ground supply plug compartment is controlled by the GPB and the ground services isolate contactor. It is lit when a satisfactory ground supply is present at the ground supply plug, but both the main a.c. distribution system and the ground services distribution system are isolated from the supply.

A GRD LIGHTING control toggle switch is fitted on the flight compartment left-hand racking panel 20-215 to provide on/off control of the power supply to the ground service lights 28 V a.c. busbar.

R B. Functional Description (Ref. Fig. 008)
(Sheet 1 of 2)
(Sheet 2 of 2)

Whereas primary control of ground power is through the ground power control (CLOSE/TRIP) switch or the GROUND SERVICE control switch for particular distribution requirements, other automatic functions are necessary to establish ground power supply conditions and apply the required protection.

The function of the ground power protection unit and associated controls is as follows:

(1) A contactor in the external ground power supply rig is initially energized by a local (rig) 28 V d.c. supply when the control switch on the rig is operated. Three-phase power is thereby connected

TO BE ISSUED LATER

- Ground Power Control - Simplified Schematic

R Figure 008

TO BE ISSUED LATER

R - Ground Power Control - Simplified Schematic
Figure 008

through the ground power supply plug and energizes the transformer-rectifier in the ground power protection unit so that power is applied to the unit fault sensing and logic control circuits, and a d.c. supply is available to energize the split system breakers (SSBs) and bus-tie breakers (BTBs) of the main a.c. generation system (Ref. 24-21-00). This d.c. supply also provides a power source for the interphone system while the GPB is open (Ref. 23-41-00).

(2) If the supply voltage, frequency and phase rotation are correct and no feeder fault exists, the final logic gate of the protection circuits applies a logic '1' to the amplifier controlling relay RL1, completing the earth return circuit and thereby causing relay RL1 to be energized. In consequence -

(a) one contact of relay RL1 connects a supply to illuminate the GRD PWR AVAILABLE caption, bring on the GROUND POWER AVAILABLE indicator light, and arm the control circuit of the GROUND POWER NOT IN USE indicator light for operation, and

(b) another contact of relay RL1 arms the control circuit of the GPB and also applies a signal to the control amplifier of relay RL3 thereby causing relay RL3 to be energized. In consequence -

b1) one contact of relay RL3 connects a 28 V 'hold-on' supply to the coil of the contactor in the ground supply rig in place of the local (rig) supply thereby maintaining connection of the power supply through the ground supply plug when the control switch on the supply rig is released, and

b2) another contact of relay RL3 arms relay RL2 which controls the operation of the GPB. Thus, if the ground services isolate contactor is closed (ground service control switch at ON) the power supply is connected to the ground services distribution system through the ground power busbar.

(3) Setting the ground power control switch momentarily to CLOSE causes relay RL2 to be energized by a

supply via the arming contact of relay RL3, through RL2 coil and then to earth through RL2 amplifier. Thus operated, one contact of relay RL2 shunts the ground power control switch to latch itself 'on' and another completes the coil control circuit of the GPB previously armed by relay RL1. Provided then that no generator circuit breaker (GCB) in the main generation system is energized and no 'generator ready' signal is given by the control and protection unit (CPU) of any main generating channel (Ref. 24-21-00), the GPB closes to connect ground power to the main a.c. distribution system through the SSBs.

(4) Since the control circuits of both SSBs and all four BTBs are armed by the 28 V supply from the ground power protection unit, ground power can be connected to all a.c. busbars of the main a.c. distribution system by appropriate setting of the SSB and BTB control switches (SSB switches set to CLOSE, BTB switches at NORM). Phase sense monitoring is inhibited immediately RL2 is energized.

NOTE: If a BTB control switch is selected to TRIP while ground power is connected to the main a.c. distribution system, the associated BTB is automatically re-energized when the switch is returned to NORM. The RESET position of the BTB control switch is associated with fault protection circuits effective during operation of the main a.c. generation system (Ref. 24-21-00).

(5) Setting the ground power control switch momentarily to TRIP connects a positive signal to the input of the control amplifier of relay RL2. This signal is inverted to 'switch-off' the amplifier, thereby effectively removing the earth return circuit and so de-energizing and unlatching relay RL2. The GPB is de-energized and ground power thereby disconnected from the main a.c. distribution system but, since relays RL1 and RL3 remain energized, the GRD PWR AVAILABLE caption remains illuminated, the GROUND POWER AVAILABLE indicator lamp remains on and the ground supply is available to power the ground services distribution system and/or the main a.c. distribution system as required.

(6) If a power malfunction is sensed, the output from the final logic gate of the protection circuits applies a logic '0' to the amplifier controlling

relay RL1. In consequence, relays RL1, RL2 and RL3 are all de-energized. The GPB and the contactor in the ground power supply rig are then de-energized, the GRD PWR AVAILABLE caption is extinguished, the GROUND POWER AVAILABLE indicator light goes out and the ground power supply is isolated from the aircraft ground supply feeder cables and hence from all aircraft busbars.

(7) If ground power is faulty on initial connection, the monitoring circuits prevent relay RL1 from becoming energized. Thus, connection of a faulty ground power supply to the main a.c. distribution system is prevented and disconnection of such a supply from the aircraft ground supply feeder cables, and so from the ground services distribution system, is immediate on release of the control switch on the ground supply rig.

(8) Normally-closed contacts of four GCB control relays, one in each main generation CPU (Ref. 24-21-00), are series-connected in the GPB coil circuit. The GPB control relay in any main generating channel is energized when the voltage and frequency of that channel are within predetermined limits. Thus, as a main engine is started, the GPB is automatically de-energized to disconnect ground power from the main a.c. distribution system when the associated main generator attains the specified voltage and frequency. The TEST facility for main generators (Ref. 24-21-00) inhibits this function and prevents the associated generator from coming on-line.

(9) Normally-closed auxiliary contacts of the four GCBs in the main generation system are series-connected in the GPB coil circuit. This prevents the GPB from closing if any main generator is supplying power to the main a.c. distribution system.

R

(10) When the equipment bay cooling system is set for the normal ground state, the air extraction fans are energized on closure of the GPB and, with adequate air flow, the contacts of both the forward and rear extraction duct pressure switches are opened (Ref. 21-21-00). If the air flow is inadequate, however, and the contacts of either the forward or rear duct pressure switches are closed, failure warning and ground power control circuits are completed via auxiliary contacts of the GPB. In consequence -

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(a) the ground call horn is switched on to give immediate warning of equipment bay cooling failure, and

(b) the ground power control relay is energized after a time delay of 45 s.

When energized, the ground power control relay inhibits the GPB 'close' control and completes the trip control circuit of the GPB, bypassing the ground power control switch contacts. The GPB is therefore tripped in the same manner and with the same results as described in the preceding paragraph (5).

Automatic tripping of the GPB by a cooling bay fault can be inhibited by setting the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch to OVERRIDE under the conditions described in the preceding paragraph 8.A.

R **ON A/C 001-005,

EXTERNAL POWER - TROUBLE SHOOTING

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

THE AIRCRAFT ENGINES MUST NOT BE RUN DURING THE FOLLOWING TROUBLE SHOOTING PROCEDURES.

R **ON A/C 001-005,

1. General

Faults are dealt with on a probability basis and identified as a result of testing.

The defect can be isolated with the aid of trouble shooting procedures (Ref. paras.3. and 4.), and traced through IF OK and IF NOT OK paths to the appropriate charts or other specified rectification action as may be necessary. If a defect occurs, perform the appropriate rectification action, then repeat the operation at which the defect was encountered to ensure that the operation is OK.

Bracketed numbers in the procedures and charts indicate items on the component identification table (Ref. Table 101). The table provides information, including component location, required for rectification. Component location also indicates the possible necessity of repositioning certain items of ground service equipment. Each chart also specifies the ground equipment required for that particular task.

All procedures dealing with trouble shooting are based on the assumption that electrical wiring is serviceable, all associated circuit breakers are set and electrical power is available, unless otherwise stated. If the fault is not rectified, check the wiring in accordance with the Wiring Diagram Manual (Ref. Table 101).

The circuits for Nos.1, 2, 3 and 4 power distribution channels are similar. Therefore, where equipment identical in each channel is involved, trouble shooting for No.1 channel is given by the first component reference (Table 101) and for Nos.2, 3 and 4 channels, in that order, by the subsequent component references. E.g., on Chart 104 - 'Check 28 V d.c. at terminal 2 of BTB Control Switch (18), (19), (20), or (21); e.g., (18) = No.1 channel, (19) = No.2 channel, etc.

2. Preparation

A. Check that the ground power supply is of the correct

frequency, voltage and phase rotation.

B. Ensure that the ground power supply is switched 'off' at source and that the supply connector is clean, dry and undamaged.

C. Check that the cable support device attached to the ground power cable is serviceable.

D. Open the ground power supply plug hinged access panel and check that the ground supply plug is clean, dry and undamaged.

E. Disengage the cable support stirrup (hook) from the spring clip in the ground supply plug compartment and position the hook in readiness for engagement with the cable support device.

F. Ensure that the aircraft is safe for the ground power supply to be connected and applied to the aircraft distribution system.

G. Connect the ground power supply connector to the aircraft ground supply plug and connect the cable support device to the hook.

R **ON A/C 001-005,

H. Ensure that both battery control switches are at BATT OFF.

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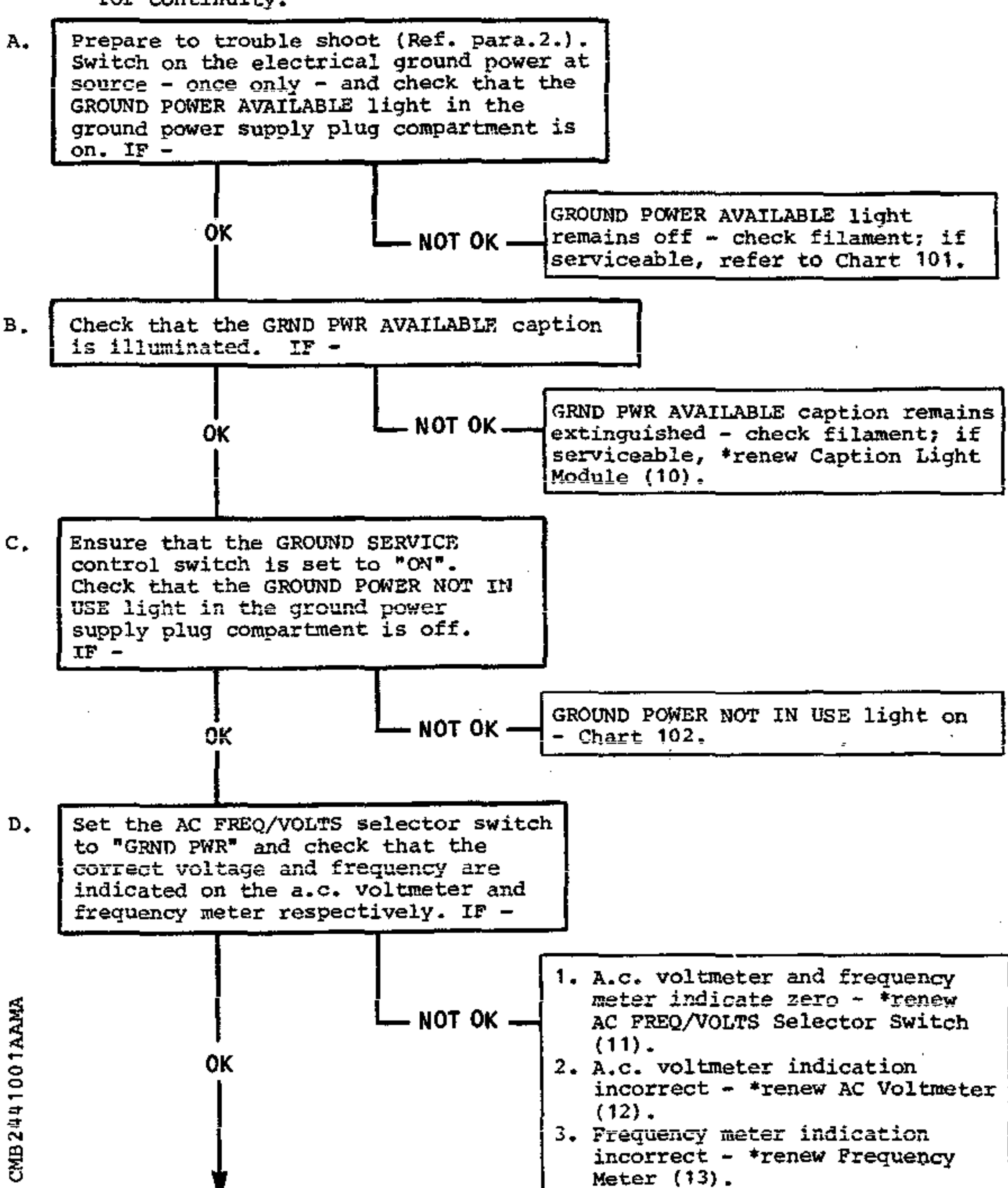
R **ON A/C 001-005,

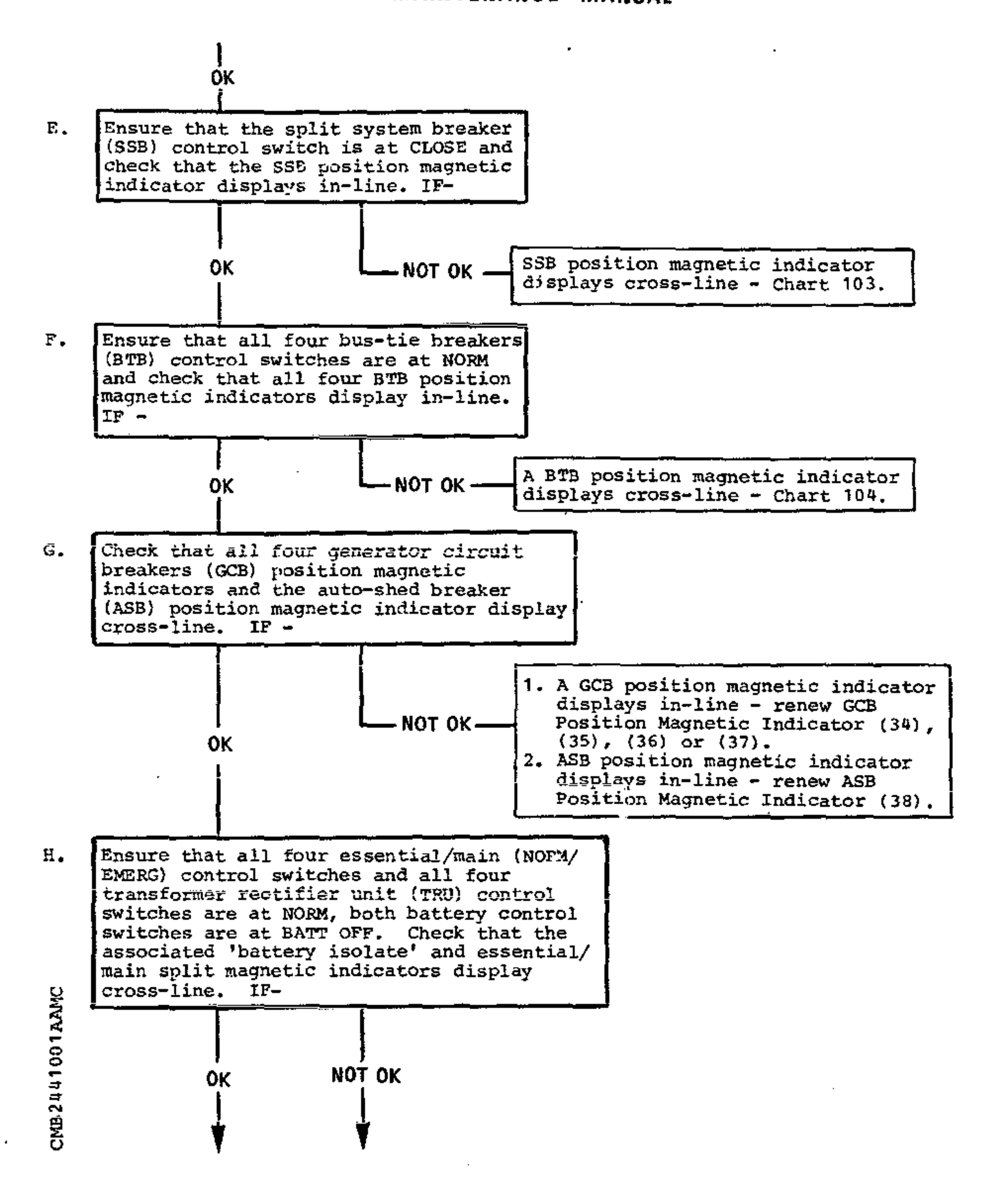
R **ON A/C 001-005,

R **ON A/C 001-005,

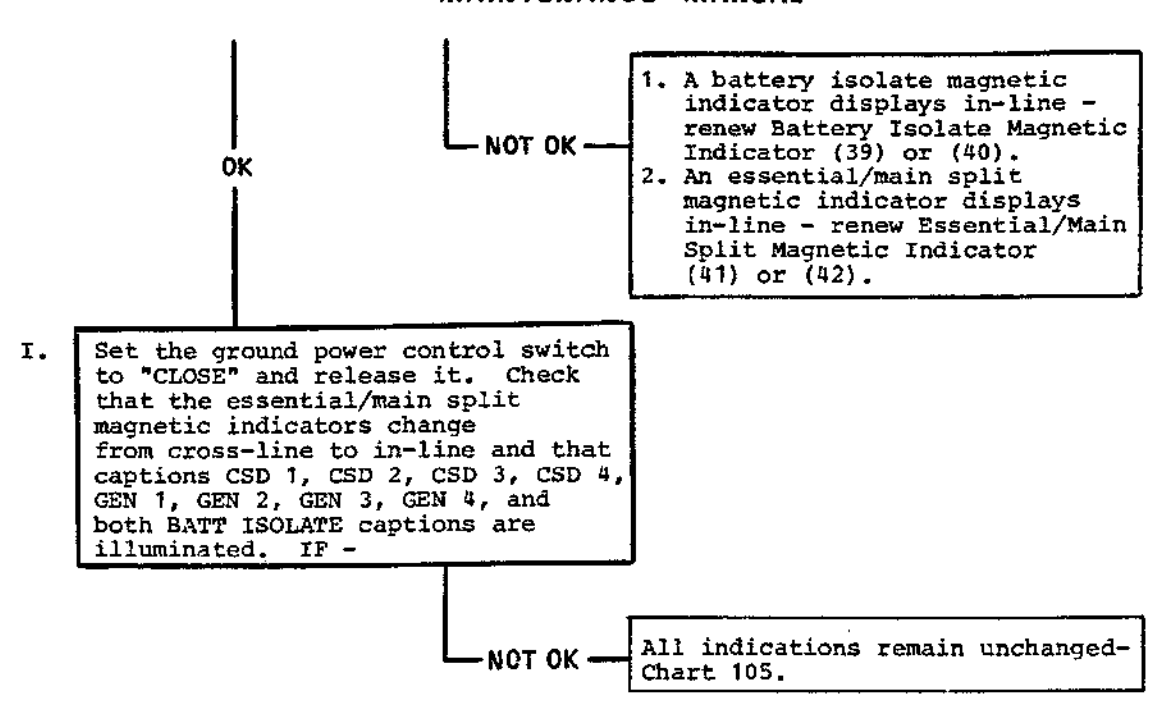
3. Trouble Shooting - Connection of Ground Power

NOTE: Before renewal of components (*) check the associated run of wiring for continuity.



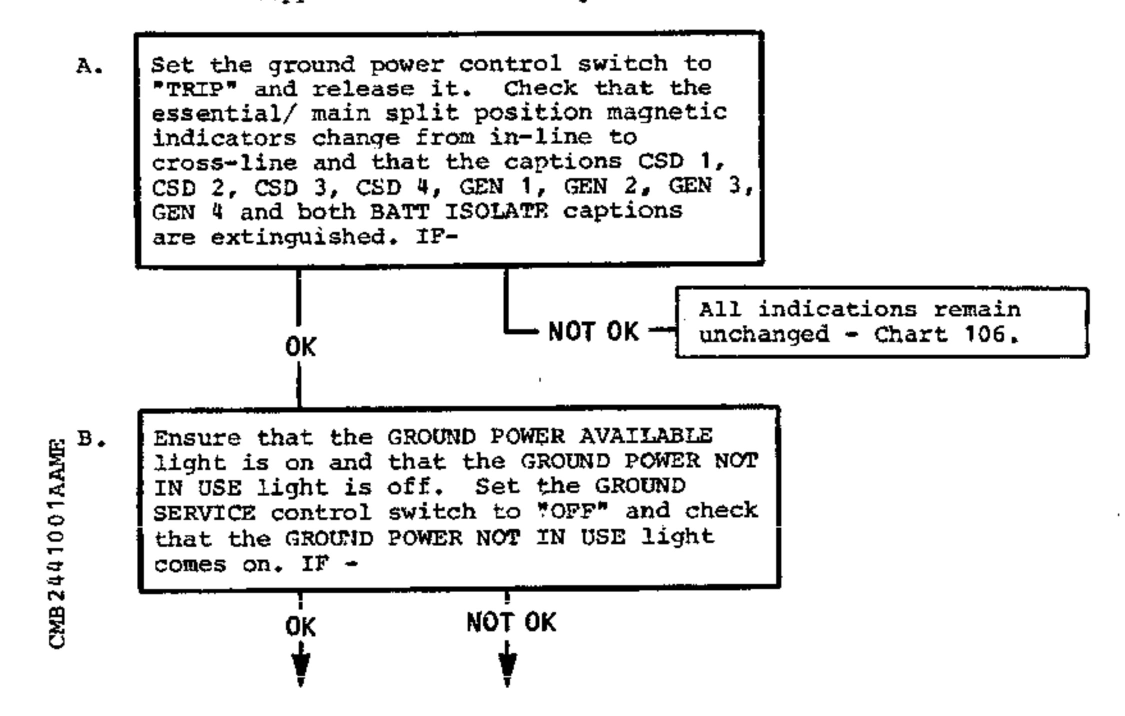


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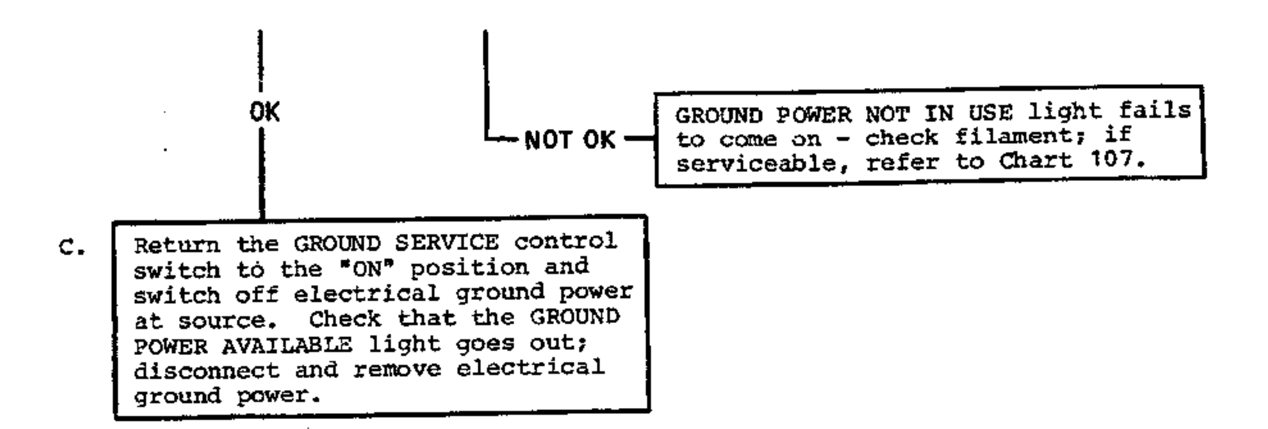


4. Trouble Shooting - Disconnection of Ground Power

NOTE: Ensure that all main generators are 'off-line', i.e., engines stopped and both battery control switches set to BATT OFF.



CMB2441001AAME

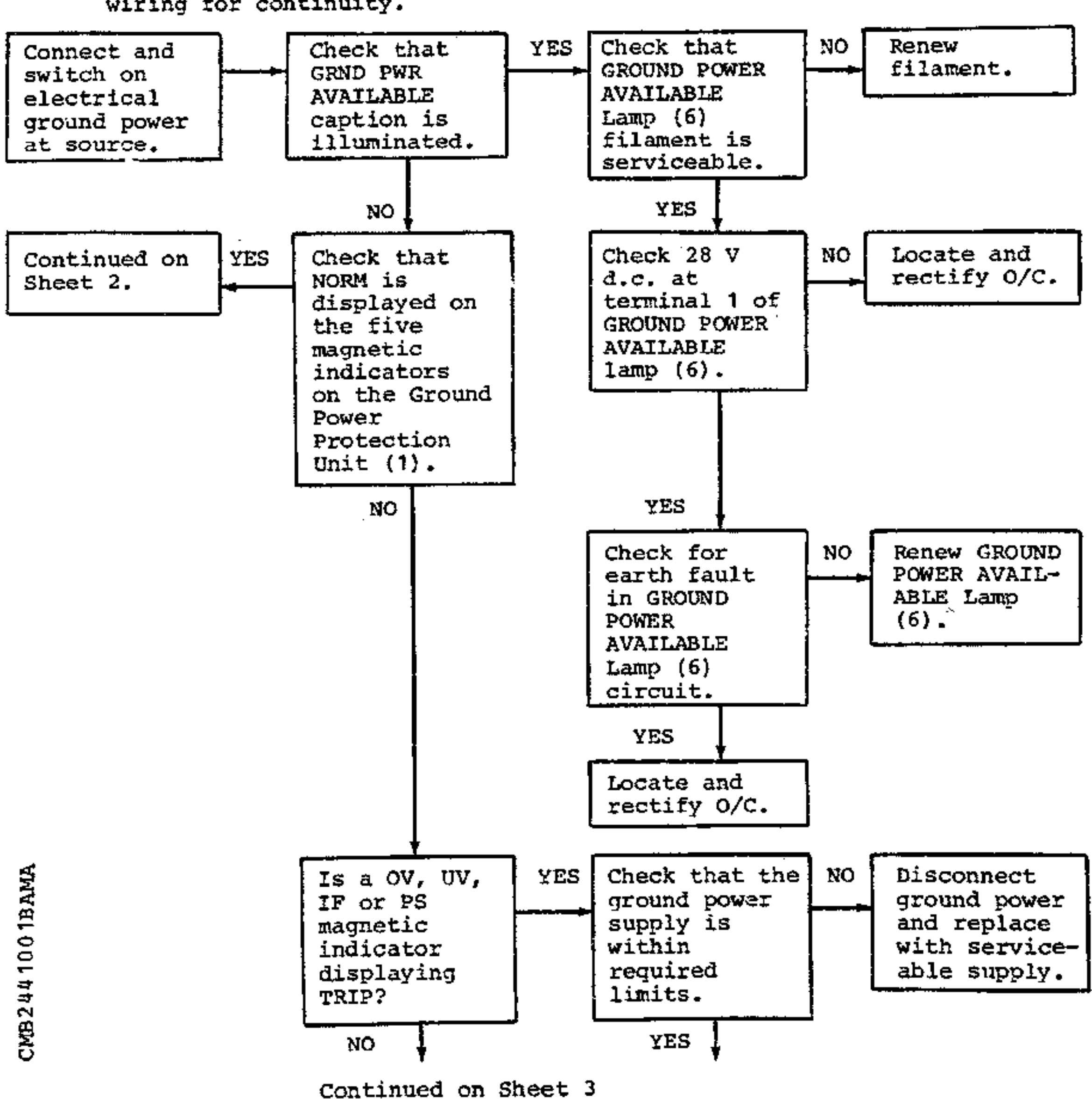


CMB2441001AAMF

'GROUND POWER AVAILABLE' LIGHT REMAINS OFF WHEN ELECTRICAL GROUND POWER IS CONNECTED AND SWITCHED ON AT SOURCE.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*) check the associated run of wiring for continuity.



CMB2441001BAMA

Chart 101 (Sheet 1 of 4)

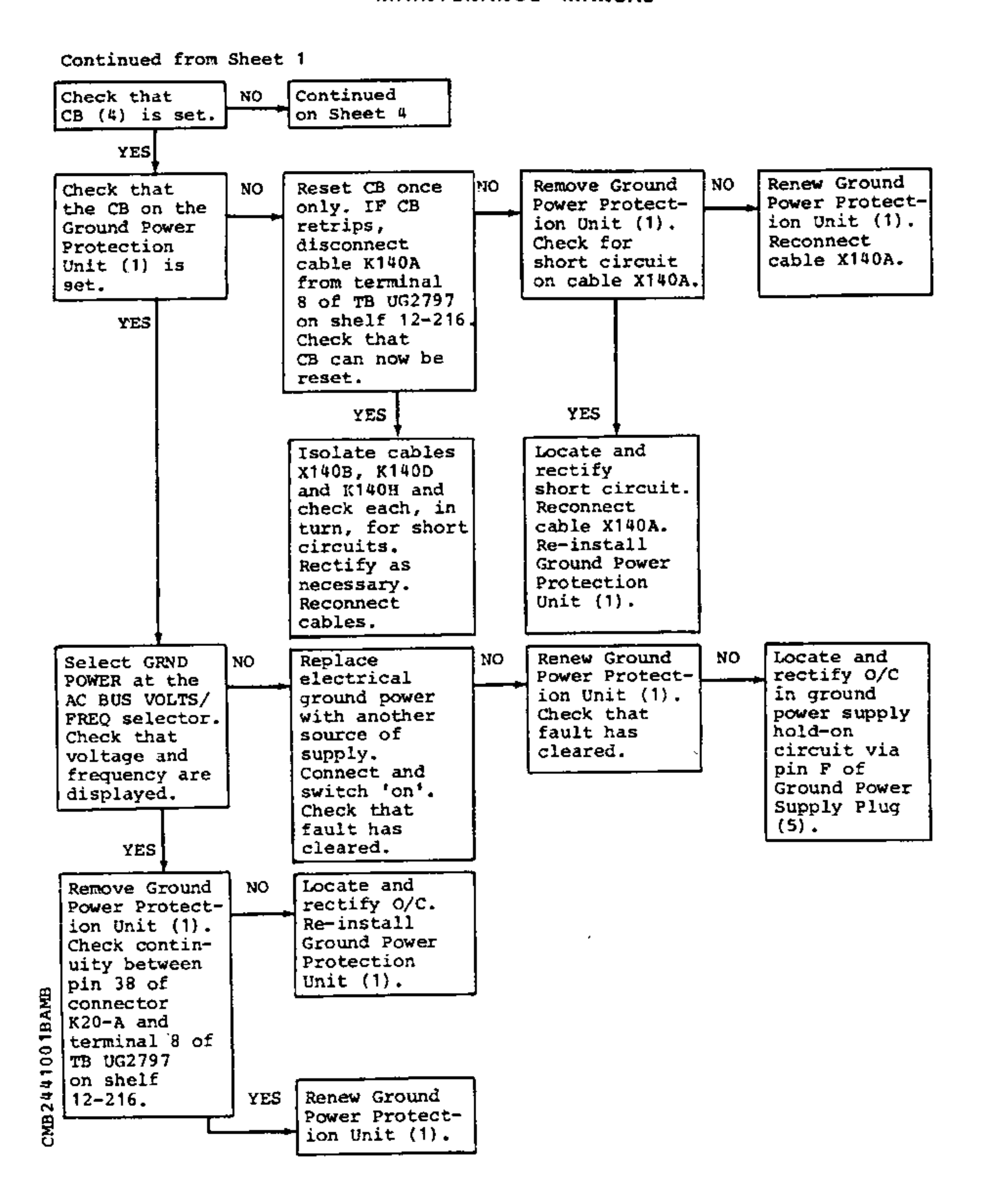


Chart 101 (Sheet 2 of 4)

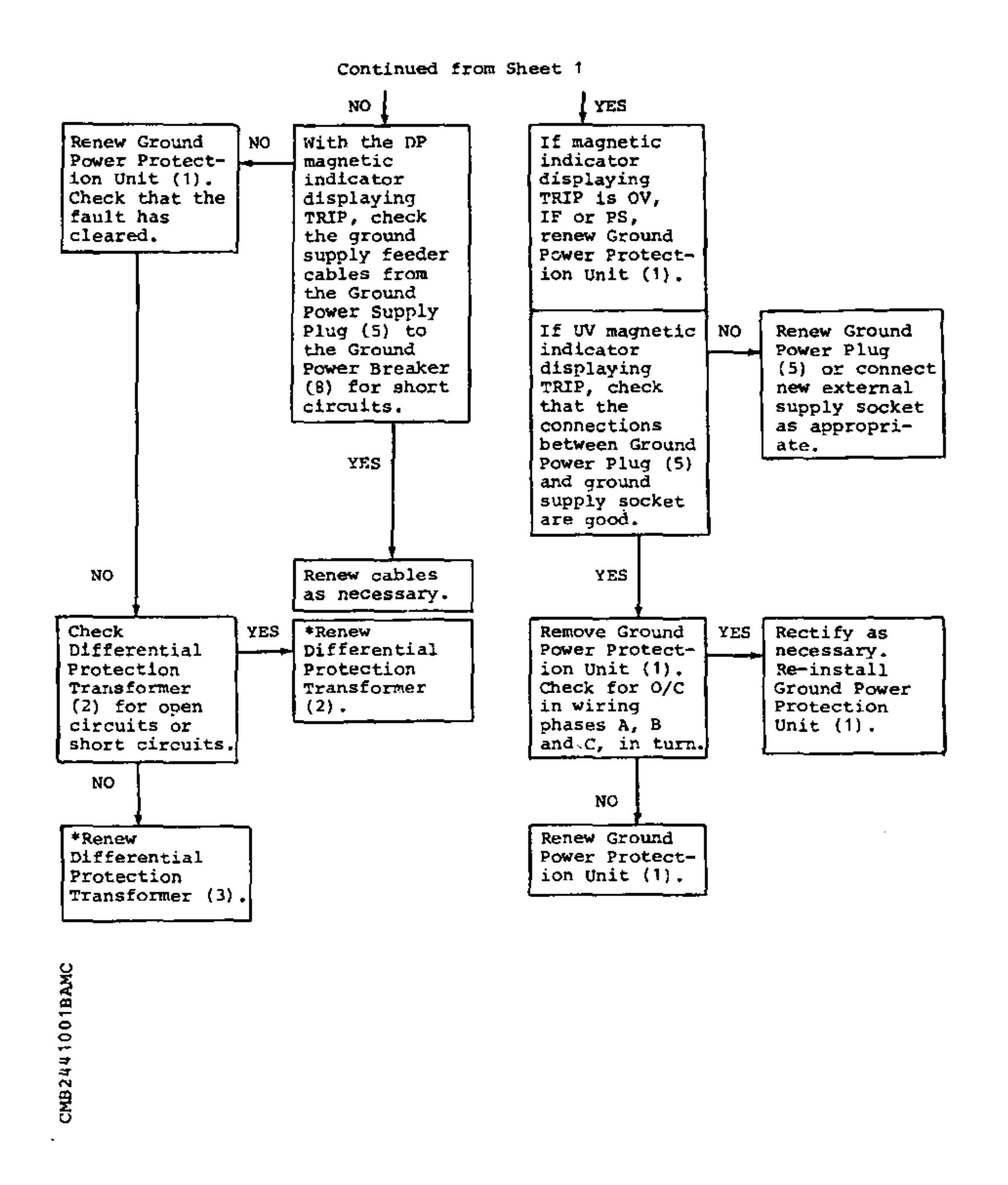
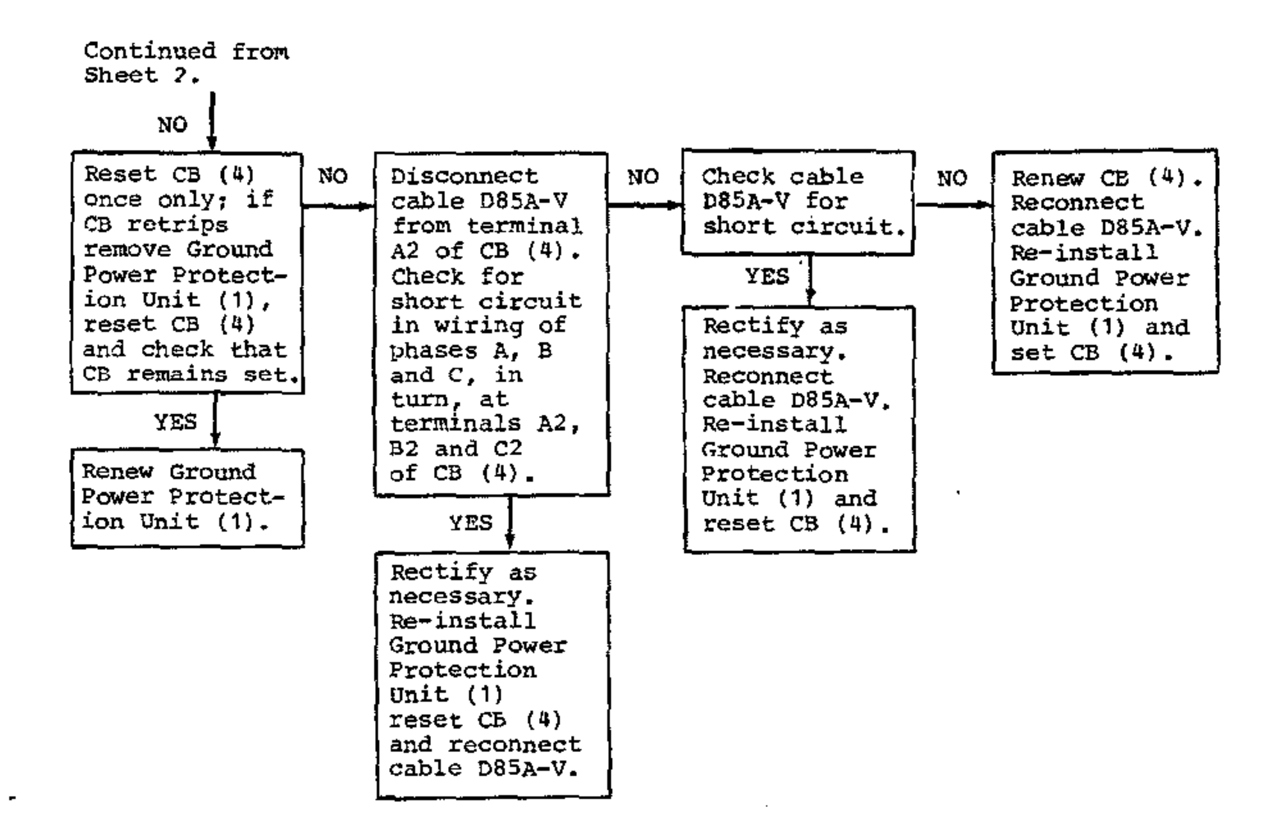
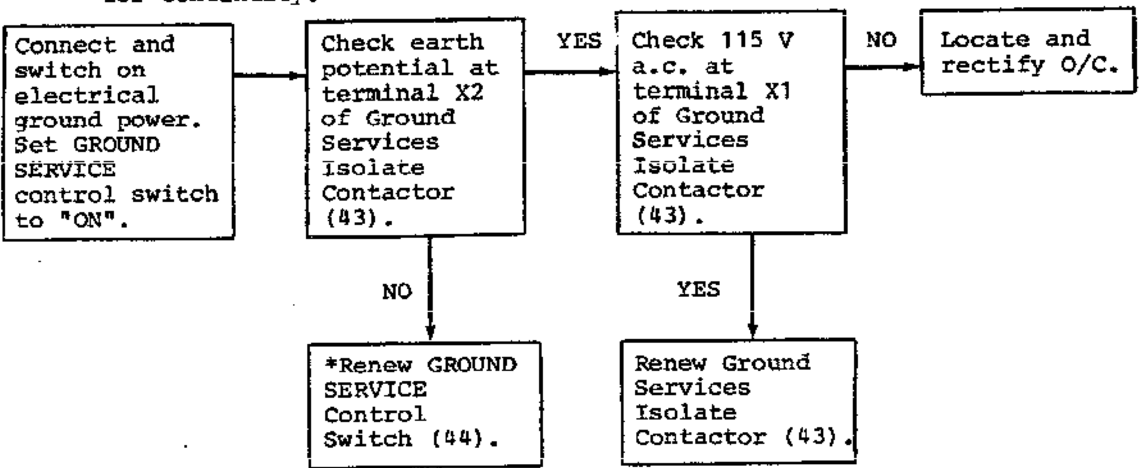


Chart 101 (Sheet 3 of 4)



CMB2441001BAME

Chart 101 (Sheet 4 of 4)



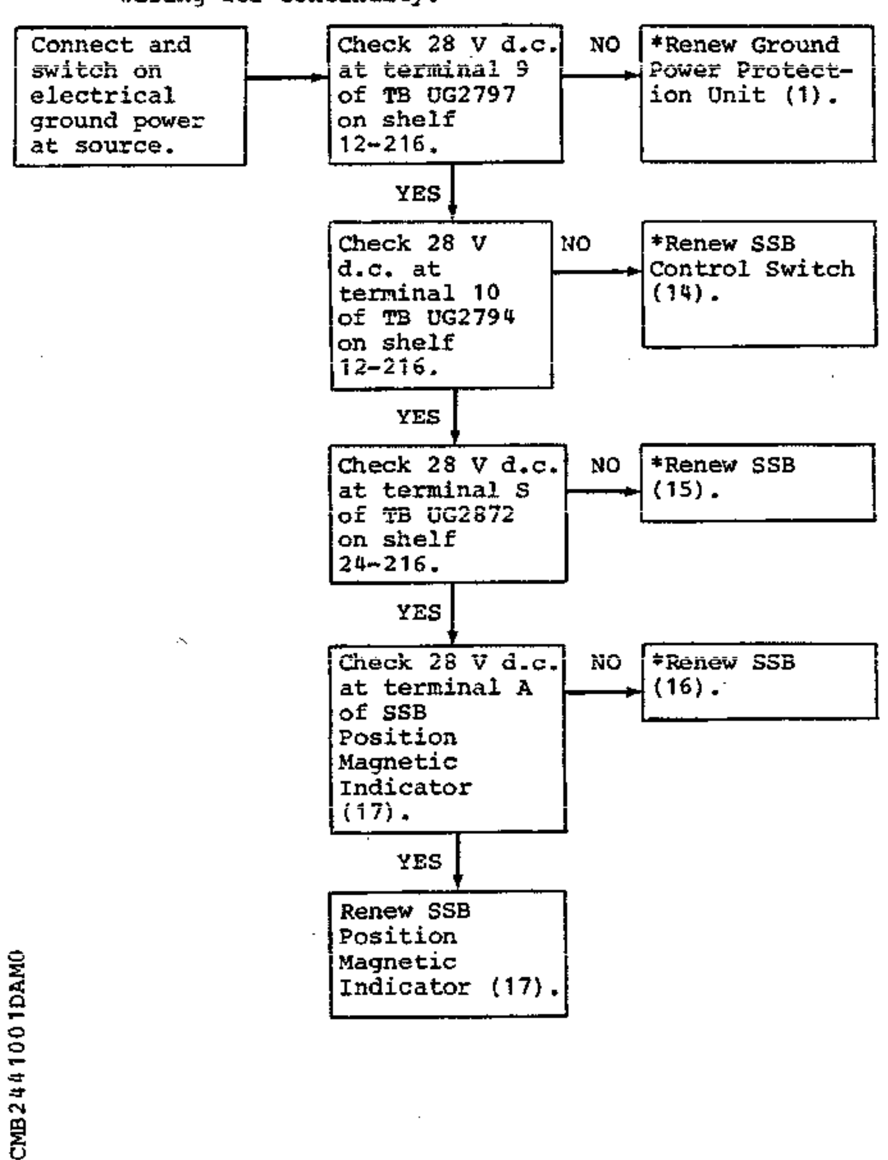
CMB2441001CAM0

Chart 102

SSB POSITION MAGNETIC INDICATOR DISPLAYS CROSS-LINE WITH ELECTRICAL GROUND POWER CONNECTED AND SWITCHED ON AT SOURCE, AND SSB CONTROL SWITCH CLOSED.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*) check the associated run of wiring for continuity.



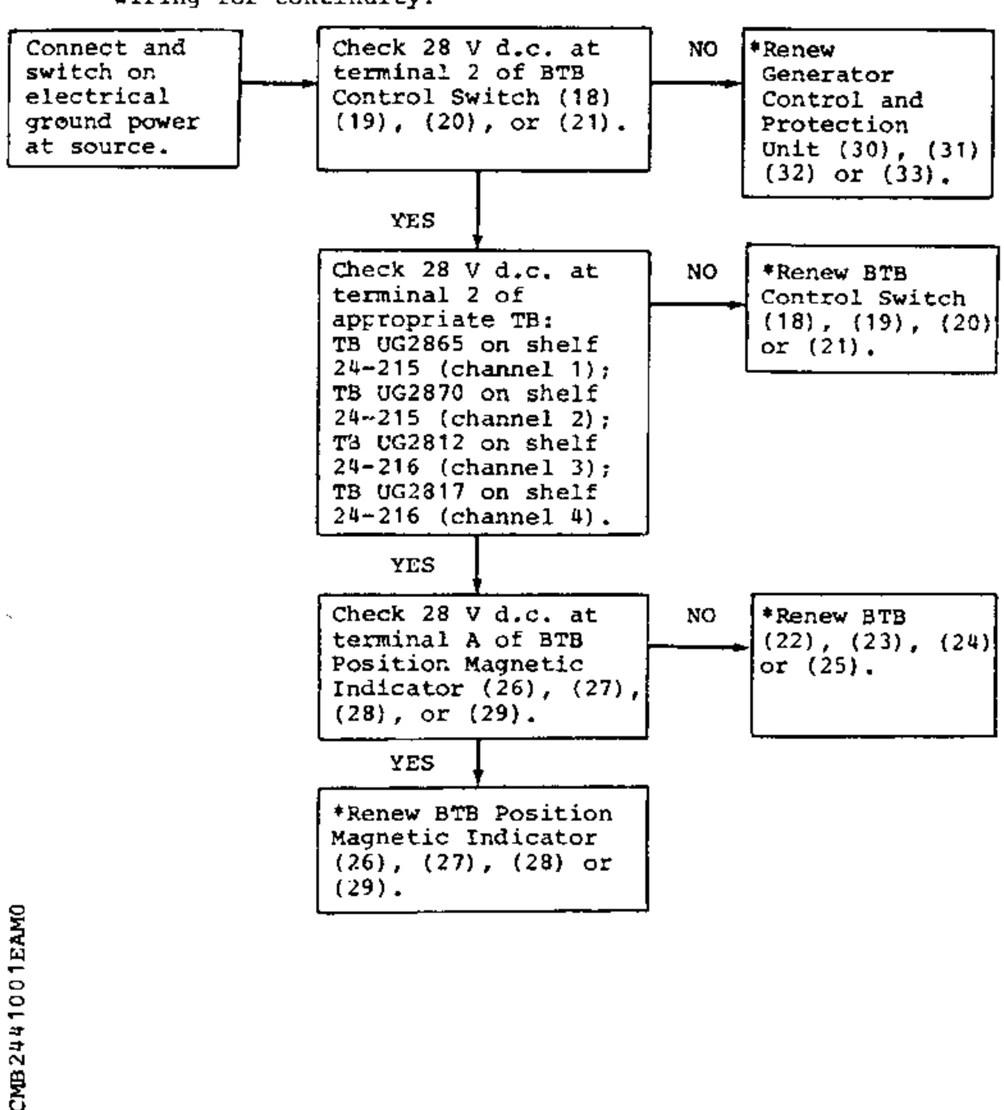
CMB2441001DAM0

Chart 103

A BTB POSITION MAGNETIC INDICATOR DISPLAYS CROSS-LINE WITH ELECTRICAL GROUND POWER CONNECTED AND SWITCHED ON AT SOURCE, AND ASSOCIATED BTB CONTROL SWITCH AT 'NORM'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*) check the associated run of wiring for continuity.



CMB2441001EAM0

Chart 104

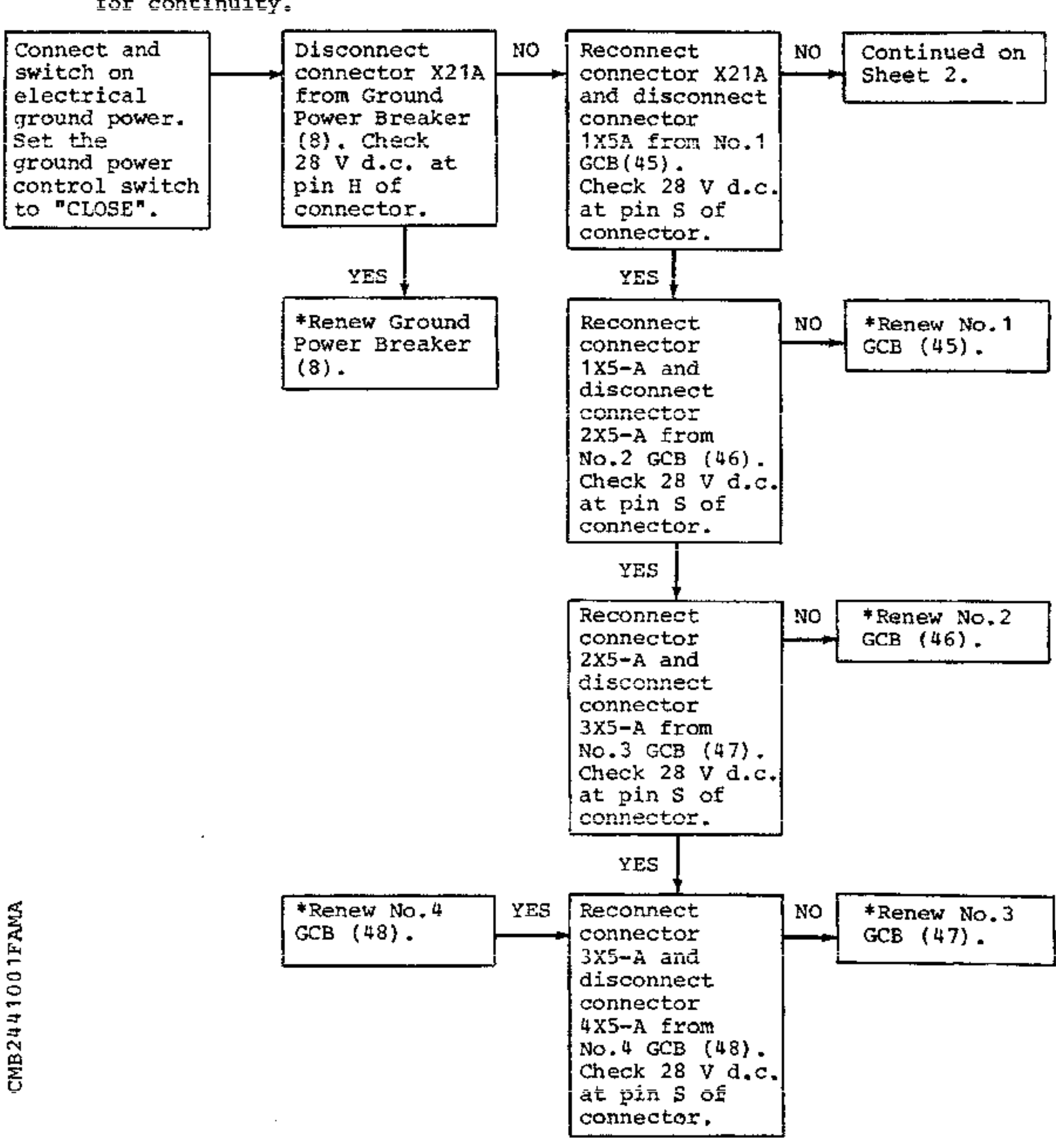


Chart 105 (Sheet 1 of 2)

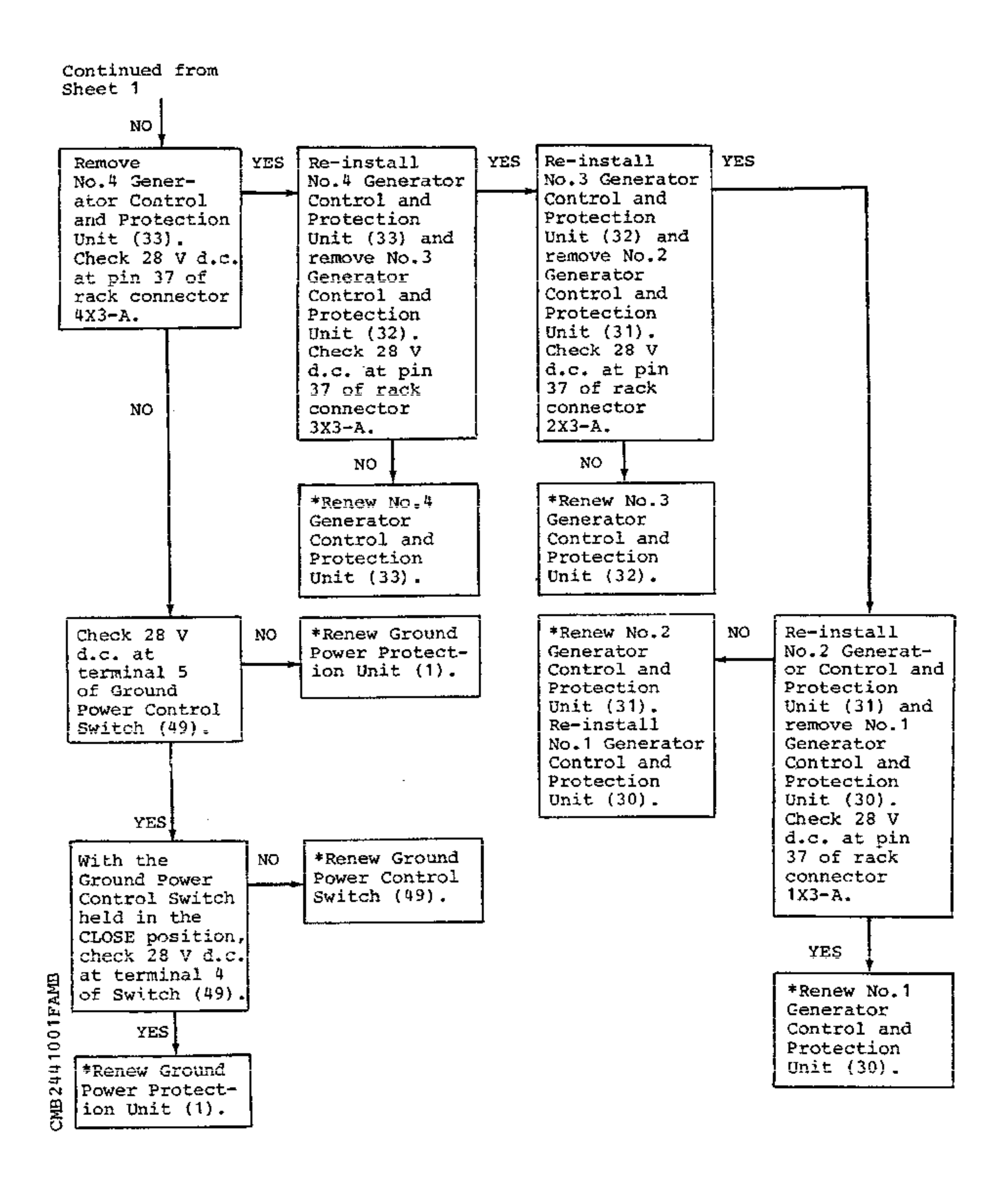
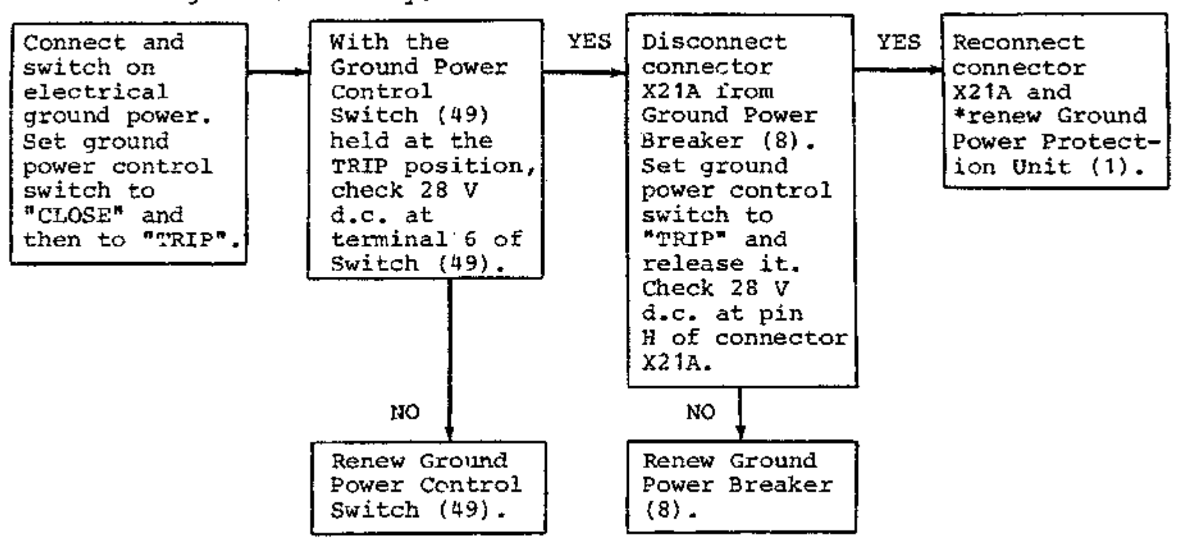


Chart 105 (Sheet 2 of 2)



CMB2441001GAM0

Chart 106

'GROUND POWER NOT IN USE' LIGHT FAILS TO COME ON WITH ELECTRICAL GROUND POWER CONNECTED AND SWITCHED ON AT SOURCE, AND GROUND SERVICE CONTROL SWITCH SET TO 'OFF'.

GROUND EQUIPMENT REQUIRED	
DESCRIPTION	PART NO.
GROUND POWER SUPPLY	-
MULTIMETER	-

NOTE: Before renewal of components (*) check the associated run of wiring for continuity.

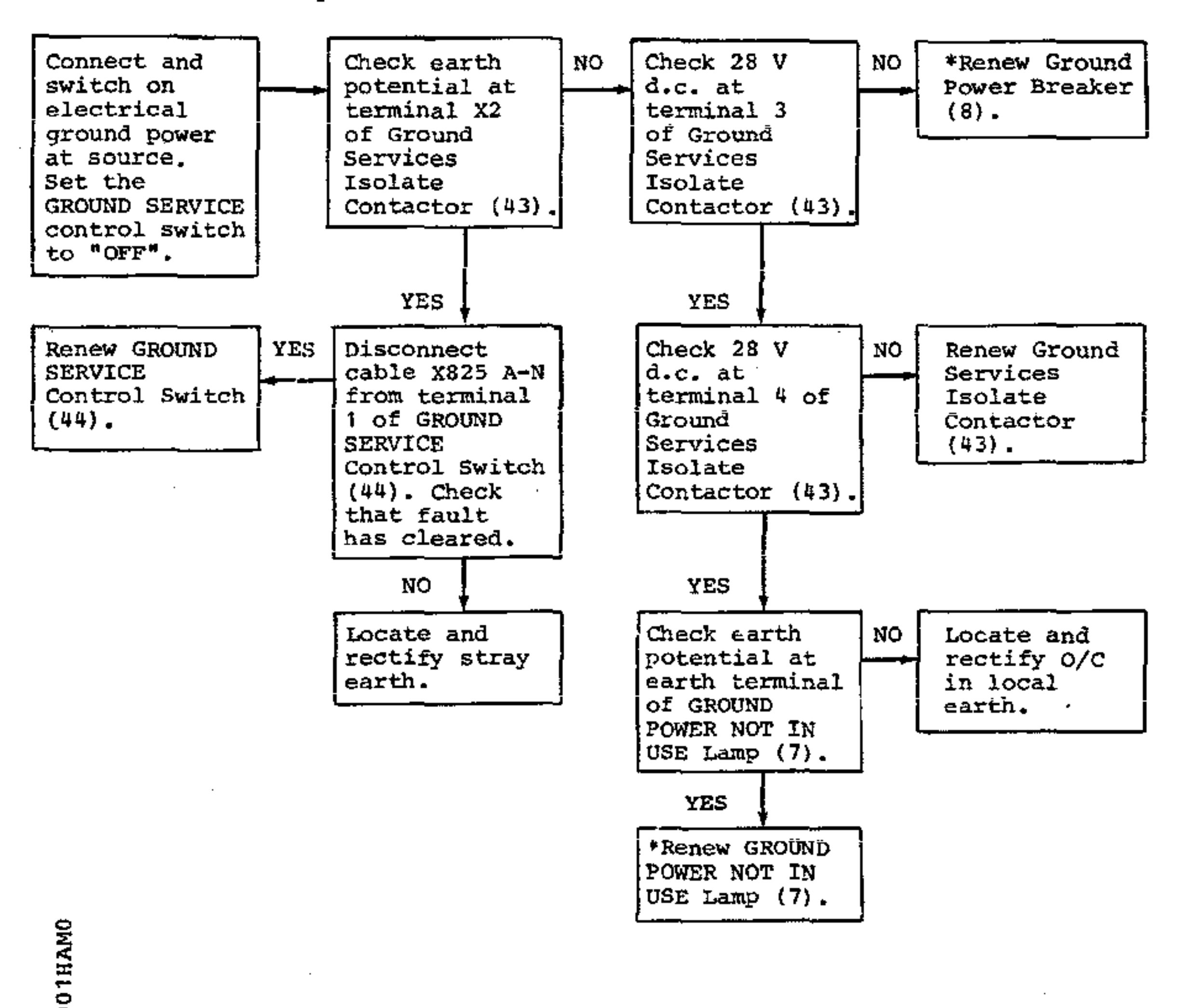


Chart 107

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
(1) Ground power protection unit	-	1-216	X20	Flight comp't RH racking	24-41-11 R/I	
(2) Differ- ential protection transformer	-	128	X18	RH side nose landing gear bay	24-41-14 R/I	
(3) Differ- ential protection transformer	-	24-216	X19	Flight comp't RH racking	24-41-14 R/I	
(4) Circuit breaker 115 V	-	25-216	X30	Map ref. B2	24-50-00 R/I	
(5) Ground power plug	-	128	X17-A	RH side nose landing gear bay	24-41-13 R/I	
(6) GROUND POWER AVAILABLE lamp	-	128	X32	RH side nose landing gear bay	24-41-00 R/I	
(7) GROUND POWER NOT IN USE lamp	-	128	X33	RH side nose landing gear bay	24-41-00 R/I	
(8) Ground power breaker	-	24-216	X21	Flight comp't RH racking	24-00-00 R/I	
(9) Ground service isolate contactor	-	26-216	X366	Flight comp't RH racking	24-00-00 R/I	
(10) GRND PWR AVAILABLE caption	-	3-214	X23	3CM station	24-00-00 R/I	

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
light module						
(11) AC FREQ/ VOLTS selector switch	-	6-214	D115	3CM station	24-00-00 R/I	
(12) AC voltmeter	-	6-214	D113	3CM station	24-00-00 R/I	
(13) Frequency meter	-	6-214	D114	3CM station	24-00-00 R/I	
(14) SSB control switch	-	3-214	X26	3CM station	24-00-00 R/I	
(15) No.1 split system breaker	-	24-215	X24	Flight comp't LH racking	24-00-00 R/I	
(16) No.2 split system breaker	-	24-216	X25	Flight comp't RH racking	24-00-00 R/I	
(17) SSB position magnetic indicator	-	3-214	X27	3CM station	24-00-00 R/I	
(18) No.1 BTB control switch	-	3-214	1X9	3CM station	24-00-00 R/I	
(19) No.2 BTB control switch	-	3-214	2X9	3CM station	24-00-00 R/I	
(20) No.3 BTB control switch	-	3-214	3X9	3CM station	24-00-00 R/I	
(21) No.4 BTB control switch	-	3-214	4X9	3CM station	24-00-00 R/I	
(22) No.1 bus-tie breaker	-	24-215	1X6	Flight comp't LH racking	24-00-00 R/I	
(23) No.2 bus-	-	24-215	2X6	Flight	24-00-00	

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
tie breaker				comp't LH racking	R/I	
(24) No.3 bus-tie breaker	-	24-216	3X6	Flight comp't RH racking	24-00-00 R/I	
(25) No.4 bus-tie breaker	-	24-216	4X6	Flight comp't RH racking	24-00-00 R/I	
(26) No.1 BTB position magnetic indicator	-	24-215	1X6	Flight comp't LH racking	24-00-00 R/I	
(27) No.2 BTB position magnetic indicator	-	24-215	2X6	Flight comp't LH racking	24-00-00 R/I	
(28) No.3 BTB position magnetic indicator	-	24-216	3X6	Flight comp't RH racking	24-00-00 R/I	
(29) No.4 BTB position magnetic indicator	-	24-216	4X6	Flight comp't RH racking	24-00-00 R/I	
(30) No.1 generator control and protection unit	-	2-215	1X3	Flight comp't LH racking	24-21-21 R/I	
(31) No.2 generator control and protection unit	-	1-215	2X3	Flight comp't LH racking	24-21-21 R/I	
(32) No.3 generator	-	1-216	3X3	Flight comp't	24-21-21 R/I	

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
control and protection unit				RH racking		
(33) No.4 generator control and protection unit	-	2-216	4X3	Flight comp't RH racking	24-21-21 R/I	
(34) No.1 GCB position magnetic indicator	-	3-214	1X8	3CM station	24-00-00 R/I	
(35) No.2 GCB position magnetic indicator	-	3-214	2X8	3CM station	24-00-00 R/I	
(36) No.3 GCB position magnetic indicator	-	3-214	3X8	3CM station	24-00-00 R/I	
(37) No.4 GCB position magnetic indicator	-	3-214	4X8	3CM station	24-00-00 R/I	
(38) ASB position magnetic indicator	-	6-214	X225	3CM station	24-00-00 R/I	
(39) 'A' system battery isolate magnetic indicator	-	6-214	1P31	3CM station	24-00-00 R/I	
(40) 'B" system battery isolate magnetic indicator	-	6-214	2P31	3CM station	24-00-00 R/I	

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	WIRING DIAGRAM
(41) 'A' system essential/ main split magnetic indicator	-	6-214	1P14	3CM station	24-00-00 R/I	
(42) 'B' system essential/main split magnetic indicator	-	6-214	2P14	3CM station	24-00-00 R/I	
(43) Ground services isolate contactor	-	26-216	X366	Flight comp't RH racking	24-00-00 R/I	
(44) GROUND SERVICE control switch	-	1-221	X367	Forward vestibule	24-41-00 R/I	
(45) No.1 generator circuit breaker	-	24-215	1X5	Flight comp't LH racking	24-00-00 R/I	
(46) No.2 generator circuit breaker	-	24-215	2X5	Flight comp't LH racking	24-00-00 R/I	
(47) No.3 generator circuit breaker	-	24-216	3X5	Flight comp't RH racking	24-00-00 R/I	
(48) No.4 generator circuit breaker	-	24-216	4X5	Flight comp't RH racking	24-00-00 R/I	

ITEM NO. AND DESCRIPTION	ACCESS PANEL	PANEL/ ZONE	EQUIP. IDENT.	POSITION	MANUAL REF. MAINT. TOPIC	MANUAL REF. WIRING DIAGRAM
(49) Ground power control switch	-	3-214	X22	3CM station	24-00-00 R/I	

Component Identification
Table 101

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EXTERNAL POWER - SERVICING

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

R NOTE: Before applying electrical ground power the flight deck door is to be secured
R open.

1. General

A. Throughout the Maintenance Manual, instructions are given where applicable to 'make available electrical ground power as detailed in 24-41-00' or to 'switch off and disconnect electrical ground power as detailed in 24-41-00'.

B. These instructions are referred to this topic because of the switching procedure and precautions that must be observed. The following detailed procedures for connecting/disconnecting electrical ground power (Ref. paras.2. and 3.) must be adopted and carried out only by authorized personnel.

C. The maintenance practices involved will determine the extent to which distribution of the ground power supply is required, i.e., via the ground services distribution system to provide power for selected ground services only (Ref. para.2.A.) or further, via the main a.c. distribution system (and hence the essential a.c. and d.c. distribution systems) as required for the servicing and testing of systems and equipment (Ref. para.2.B.).

D. With a satisfactory ground supply present at the ground supply plug, the ground power control switch on the electrical generating control panel provides manual control of the ground power breaker (GPB) for connection of the supply to the main a.c. distribution system. The GROUND SERVICE control switch on the forward steward's panel controls connection of the supply to the ground services distribution system and is normally left in the ON position.

E. It is important to note the function of the GROUND POWER AVAILABLE and GROUND POWER NOT IN USE indicator lights in the ground supply plug compartment and the GRND PWR AVAILABLE caption on the main generating control panel in the flight compartment. The GROUND POWER AVAILABLE indicator light is on and the GRND PWR AVAILABLE caption is illuminated whenever a satisfactory ground supply is present at the ground supply plug and therefore available for connection to the ground services distribution system and/or the main a.c. distribution system.

F. The GROUND POWER NOT IN USE indicator light will be on only when a satisfactory ground supply is present at the ground supply plug, but both the main a.c. distribution system and the ground services distribution system are isolated from the supply.

**ON A/C 007-007,

2. Connecting Electrical Ground Power

CAUTION: ONLY AN APPROVED 200/115 V 400 Hz THREE-PHASE AC GROUND POWER SUPPLY WITH PHASE ROTATION A-B-C MAY BE CONNECTED TO THE AIRCRAFT GROUND SUPPLY PLUG.

**ON A/C 001-006,

2. Connecting Electrical Ground Power

CAUTION: ONLY AN APPROVED 200/115 V 400 Hz THREE-PHASE AC GROUND POWER SUPPLY WITH PHASE ROTATION A-B-C MAY BE CONNECTED TO THE AIRCRAFT GROUND SUPPLY PLUG.

B BEFORE CONNECTING ELECTRICAL GROUND POWER ENSURE REFUEL CONTROL PANEL
B ACCESS DOOR IS SHUT

A. Connect Electrical Ground Power to the Ground Services Distribution System

(1) Check that the ground power supply is of the correct frequency, voltage and phase rotation.

(2) Ensure that the ground power supply is switched off at source and that the supply connector is clean, dry and undamaged.

(3) Check that the cable support device attached to the ground power cable is serviceable.

(4) Open the ground supply plug hinged access panel and check that the ground supply plug is clean, dry and undamaged.

(5) Disengage the cable support stirrup (hook) from its spring clip in the ground supply plug compartment and position the hook in readiness for engaging the cable support device.

(6) Ensure that the aircraft is safe for the ground power supply to be connected and applied to the aircraft electrical distribution systems.

(7) Connect the ground power supply connector to the aircraft ground supply plug and connect the cable support device to the hook.

(8) Switch on the ground power supply at source.

(9) Check that the GROUND POWER AVAILABLE indicator light in the ground supply plug compartment is on.

(10) Ensure that the GROUND SERVICE control switch on the steward's control panel in the forward vestibule is set to ON and the GROUND POWER NOT IN USE indicator light in the ground supply plug compartment is out.

NOTE: With the GROUND SERVICE control switch set to ON and with a satisfactory supply present at the ground supply plug, the ground power busbar will be 'live' and hence power supplies will be available for the selected services supplied by the ground services distribution system. These include 'ground/flight' services, e.g., flight compartment, main cabin and navigation lights, water/waste drains, de-icing, etc., which are automatically transferred from their normal supply busbars to the ground power busbar whenever that busbar is 'live'.

'On/off' control of the power supplies to the 28 V a.c. ground service lights is provided by the GRD LIGHTING toggle switch on the oxygen panel in the flight compartment left-hand racking.

B. Connect Electrical Ground Power to the Main AC Distribution System

WARNING: BEFORE CONNECTING ELECTRICAL GROUND POWER TO THE MAIN AC DISTRIBUTION SYSTEM, CHECK THAT CIRCUIT BREAKERS IDENTIFIED WITH A RED SURROUND ARE TRIPPED AS REQUIRED (REF. PARA.4.B.).

CAUTION: BEFORE CONNECTING ELECTRICAL GROUND POWER TO THE MAIN AC DISTRIBUTION SYSTEM -

(1) ENSURE THAT THE SWITCHES ON THE EQUIPMENT BAY COOLING (EBC) PANEL ARE SET FOR THE NORMAL GROUND STATE (REF. 21-21-00, DESCRIPTION AND OPERATION),

(2) ENSURE THAT APPROPRIATE BLANKING IS FITTED IF EQUIPMENT HAS BEEN REMOVED FROM EQUIPMENT RACKING (REF. 21-21-00, SERVICING), AND

(3) CHECK THAT CIRCUIT BREAKERS IDENTIFIED WITH A WHITE SURROUND ARE TRIPPED AS REQUIRED (REF. PARA.4.C.).

(1) Connect electrical ground power, or ensure that ground power is connected, in accordance with operations (1) to (10), inclusive, given under A. 'Connect Electrical Ground Power to the Ground Services Distribution System'.

NOTE: Operation (10), given under para.A., is a normal requirement, but connection of a satisfactory ground supply to the main a.c. distribution system is not dependent on this setting of the GROUND SERVICE control switch.

(2) Set the A.C. FREQ/VOLTS selector switch on the electrical generating control panel to "GRND PWR".

(3) On the electrical generating control panel, check that -

(a) the GRND PWR AVAILABLE caption is illuminated,

(b) the correct voltage and frequency are indicated on the a.c. voltmeter and frequency meter,

(c) the split system breakers (SSBs) control switch is at CLOSE and the SSBs position magnetic indicator displays in-line,

(d) all four bus-tie breaker (BTB) control switches are at NORM and all four BTB magnetic indicators display in-line,

(e) all four generator circuit breaker (GCB) position magnetic indicators and the auto shed breaker (ASB) position magnetic indictor display cross-line,

(f) all four essential/main (NORM/EMERG) control switches are at NORM,

(g) all four transformer rectifier unit (TRU) control switches are at NORM, and

**ON A/C 007-007,

(h) both battery control switches are at OFF, the associated 'battery isolate' magnetic indicators display cross-line, the DC NORM/SPLIT control switch is at NORM, and the d.c. essential/main split magnetic indicators display cross-line.

**ON A/C 001-006,

(h) both battery control switches are at BATT OFF and the associated 'battery isolate' and 'essential/main split' magnetic indicators display cross-line.

**ON A/C 007-007,

(4) Set the ground power control switch on the main generating control panel to "CLOSE" and release it to close the GPB and thus connect the supply to the main a.c. distribution system. Check that -

(a) the 'essential/main split' magnetic indicators change from cross-line to in-line,

(b) the captions CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and the ISOL sections of both BATT-FAIL/ISOL captions are illuminated, and

(c) the indications on the EBC panel are correct for the normal ground state (Ref. 21-21-00).

NOTE: If equipment bay cooling failure (inadequate air flow in an extraction duct) is sensed after closure of the GPB, the ground call horn will sound to give immediate warning of the failure (Ref. 21-21-00) and the GPB will be tripped automatically after a time delay of 45 s. This inhibition of ground power can be overridden to facilitate the rectification of equipment bay cooling faults (Ref. para.5.).

(5) If required, make selective distribution switching.

**ON A/C 001-006,

(4) Set the ground power control switch on the main generating control panel to "CLOSE" and release it to close the GPB and thus connect the supply to the main a.c. distribution system. Check that -

(a) the 'essential/main split' magnetic indicators change from cross-line to in-line,

(b) the captions CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and both BATT ISOLATE captions are illuminated, and

(c) the indications on the EBC panel are correct for the normal ground state (Ref. 21-21-00).

**ON A/C 001-005,

NOTE: If equipment bay cooling failure (inadequate air flow in an extraction duct) is sensed after closure of the GPB, the ground call horn will sound. If this occurs, the ground power control switch must be set to TRIP and the cause investigated (Ref. 21-21-00).

(5) If required, make selective distribution switching.

**ON A/C 006-006,

NOTE: If equipment bay cooling failure (inadequate air flow in an extraction duct) is sensed after closure of the GPB, the ground call horn will sound to give immediate warning of the failure (Ref. 21-21-00) and the GPB will be tripped automatically after a time delay of 45 s. This inhibition of ground power can be overridden to facilitate the rectification of equipment bay cooling faults (Ref. para.5.).

(5) If required, make selective distribution switching.

3. Disconnecting Electrical Ground Power

A. Disconnect Electrical Ground Power

NOTE: The following disconnection procedures, (1) to (7) inclusive, are necessary when a ground supply has been connected as detailed in paragraph 2.B. 'Connect Electrical Ground Power to the Main AC Distribution System'.

Operations (1) and (2) will not apply, however, if a ground power supply has been connected only as detailed in paragraph 2.A. 'Connect Electrical Ground Power to the Ground Services Distribution System'.

**ON A/C 007-007,

(1) Ensure that both battery control switches are at OFF.

(2) Set the ground power control switch on the main generating control panel to "TRIP" and release it to trip the GPB and thus disconnect the supply from the main a.c. distribution system. Check that the captions CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and the ISOL sections of both BATT-FAIL/ISOL captions are extinguished.

NOTE: This operation is not applicable if any main generator is on line.

**ON A/C 001-006,

(1) Ensure that both battery control switches are at BATT OFF.

(2) Set the ground power control switch on the main generating control panel to "TRIP" and release it to trip the GPB and thus disconnect the supply from the main a.c. distribution system. Check that the captions CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and both BATT ISOLATE captions are extinguished.

NOTE: This operation is not applicable if any main generator is on line.

(3) Ensure that the GROUND SERVICE control switch is left in the ON position.

(4) At the ground supply plug compartment, check that the GROUND POWER AVAILABLE indicator light is on and the GROUND POWER NOT IN USE indicator light is out.

(5) Check that connection of the ground supply to the ground services distribution system is no longer required.

(6) Switch off the ground supply at source.

(7) Check that the GROUND POWER AVAILABLE and GROUND POWER NOT IN USE indicator lights are out.

(8) Remove the ground supply connector from the ground supply plug and disconnect the cable support device from the hook.

(9) Stow the hook in the spring clip in the ground supply plug compartment and shut the hinged access panel.

4. Isolation of Certain Instruments/Equipment

A. General

(1) A number of circuit breakers are identified with a coloured surround and must be tripped while the aircraft is on the ground, subject to individual test requirements.

B. Circuit Breakers with a Red Surround

(1) Two circuit breakers are identified with a red surround, one on panel 1-213 and the other on panel 3-213. These circuit breakers control supplies for ram air turbine extension circuits and are tripped for safety reasons.

C. Circuit Breakers with a White Surround

(1) Ten master circuit breakers are identified with a white surround. These master isolation circuit breakers must be tripped to avoid the unnecessary running of equipment and/or overheating of certain groups of instruments/equipment if the cooling air supply is not available or is inadequate. Each master isolation circuit breaker controls the supply to one of ten 'instrument ground disconnect' (IGD) busbars (designation XS), each of which supplies a particular group of services.

(2) The identification of each master isolation circuit breaker and the services (system circuit breakers) supplied by the associated IGD busbar are given in Table 301. Each master isolation circuit breaker is identified by the inclusion of the associated busbar designation in its title, e.g., ENG INST BUS 5XS.

SERVICE - CIRCUIT BREAKER TITLE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG INST BUS 5XS supplying:	2-213	X 351	H 4
ENG 2 EXHAUST GAS TEMP IND	2-213	2E 301	D 10
ENG 3 EXHAUST GAS TEMP IND	2-213	3E 301	D 11
ENG 2 N2 RPM IND	2-213	2E 241	D 12
ENG 3 N2 RPM IND	2-213	3E 241	D 13
ENG INST BUS 6XS supplying:	2-213	X 352	H 3
ENG 1 N2 RPM IND	2-213	1E 241	G 10
ENG 4 N2 RPM IND	2-213	4E 241	G 11
ENG 1 EXHAUST GAS TEMP IND	2-213	1E 301	G 12
ENG 4 EXHAUST GAS TEMP IND	2-213	4E 301	G 13
FLT CONT & NAV BUS 14XS supplying:	2-213	X 355	H 2
1ST PLT ADC INST SUP	2-213	1F 75	B 3
FLT CONT POSN IND 26V 400 Hz SUP	2-213	C 84	B 4
1ST PLT ACCELMTR TX SUP	2-213	F 36	B 5
HSI TRUE 1ST PLT INS 1 SUP & IND	2-213	1F 21	B 6
ADI 1ST PLT INS 1 SUP & IND	2-213	1F 15	B 7
HSI MAG 1ST PLT INS 1 SUP & IND	2-213	1F 16	B 8
AP/FD SYS 1 SUP	2-213	1C 20	C 5
RM1 VHF NAV 1 IND	2-213	1R 34	C 6
ADF 1 IND	2-213	1R 174	C 7
DME 1 IND	2-213	1S 3	C 8
FLT DATA REC TIME INPUT SUP	2-213	F 64	D 6
ADI LTS INS 3 SUP & IND	2-213	3F 15	D 7
ENG INST BUS 7XS supplying:	4-213	X 353	G 2
ENG 2 TCA & FUEL TEMP IND	4-213	2E 52	B 20
ENG 3 TCA & FUEL TEMP IND	4-213	3E 52	B 21
ENG 2 N1 RPM IND	4-213	2E 151	C 19
ENG 3 N1 RPM IND	4-213	3E 151	C 20

SERVICE - CIRCUIT BREAKER TITLE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG INST BUS 8XS supplying:	4-213	X 354	G 3
ENG 1 N1 RPM IND	4-213	1E 151	E 18
ENG 4 N1 RPM IND	4-213	4E 151	E 19
ENG 1 TCA & FUEL TEMP IND	4-213	1E 52	E 20
ENG 4 TCA & FUEL TEMP IND	4-213	4E 52	E 21
ENG 2 FUEL INST BUS 2XS supplying:	13-215	X 342	G 1
ENG 2 OIL PRESS IND	13-215	2E 65	C 13
ENG 2 P7 IND	13-215	2E 261	C 14
ENG 2 % AREA (AJ) IND	13-215	2E 81	D 13
ENG 2 OIL CONTENTS & TEMP IND	13-215	2E 232	D 14
ENG 2 FUEL FLOW IND SUP	13-215	E 472	D 16
ENG & FUEL INST BUS 3XS supplying:	13-216	X 343	G 3
ENG 3 OIL PRESS IND	13-216	3E 65	B 5
ENG 3 % AREA (AJ) IND	13-216	3E 81	B 6
ENG 3 P7 IND	13-216	3E 261	C 7
ENG 3 FUEL FLOW IND SUP	13-216	E 564	D 4
FUEL CONSUMED TOTAL/WT IND	13-216	E 473	D 5
ENG 3 OIL CONTENTS & TEMP IND	13-216	3E 232	D 6
NAV INST BUS 13XS supplying:	13-216	X 345	G 4
2ND PLT ADC INST SUP	13-216	2F 75	A 14
3CM ADC TEMP INST SUP	13-216	F 105	A 15
AP/FD SYS 2 SUP	13-216	2C 20	A 17
ADF 2 IND	13-216	2R 174	A 18
RMI VHF NAV 2 IND	13-216	2R 34	A 19
DME 2 IND	13-216	2S 3	B 19
ADI 2ND PLT INS 2 SUP & IND	13-216	2F 15	C 13
HSI MAG 2ND PLT INS 2 SUP & IND	13-216	2F 16	C 14
HSI TRUE 2ND PLT INS 2 SUP & IND	13-216	2F 21	C 15
2ND PLT ACCELMTR TX SUP	13-216	F 37	D 13

SERVICE - CIRCUIT BREAKER TITLE	PANEL	CIRCUIT BREAKER	MAP REF.
ENG & FUEL INST BUS 1XS supplying:	14-215	X 341	G 2
ENG 1 % AREA (AJ) IND	14-215	1E 81	C 13
ENG 1 OIL PRESS IND	14-215	1E 65	C 14
ENG 1 FUEL FLOW IND SUP	14-215	E 471	C 15
ENG 1 P7 IND	14-215	1E 261	D 13
ENG 1 OIL CONTENTS & TEMP IND	14-215	1E 232	D 14
ENG & FUEL INST BUS 4XS supplying:	14-216	X 344	F 1
ENG 4 FUEL FLOW IND SUP	14-216	E 565	B 3
ENG 4 % AREA (AJ) IND	14-216	4E 81	B 6
ENG 4 P7 IND	14-216	4E 261	B 7
ENG 4 OIL PRESS IND	14-216	4E 65	D 6
ENG 4 OIL CONTENTS & TEMP IND	14-216	4E 232	E 6

Master Isolation Circuit Breakers and Associated Services
Table 301

**ON A/C 006-007,

5. Override of Equipment Bay Cooling Ground Power Inhibition

A. General

(1) In the event of equipment bay cooling failure (inadequate air flow in an extraction duct) after closure of the GPB, the ground call horn will sound to give immediate warning of the failure and the GPB will be tripped automatically after a time delay of 45 s. This inhibition of ground power can be overridden by the use of the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch, which is located behind circuit breaker panel 15-216 in the flight compartment right-hand racking.

WARNING: THE "EQUIPMENT BAY COOLING GROUND POWER INHIBIT" SWITCH IS LOCATED IN PROXIMITY TO ELECTRICAL EQUIPMENT WHICH IS 'LIVE' WHEN POWER SUPPLIES ARE CONNECTED TO THE MAIN A.C. DISTRIBUTION SYSTEM.

(2) The EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch has two positions, NORMAL and OVERRIDE, which are effective as follows:-

(a) NORMAL: Guarded. In the event of equipment bay cooling failure, the GPB will be tripped automatically as described above.

(b) OVERRIDE: Solenoid-held position - spring-return to NORMAL. This setting prevents further tripping of the GPB by an equipment bay cooling failure.

(3) The setting to the OVERRIDE position is maintained when -

(a) the setting is made within a period of 45 s after the GPB has closed, and

(b) an equipment bay cooling fault causing previous tripping of the GPB has not been cleared, i.e., the contacts of an extraction duct pressure switch remain closed.

(4) When the fault is cleared or the GPB is tripped the switch will return automatically to the NORMAL position.

B. Override Procedure

(1) If not already tripped, trip the GPB by setting the ground power control switch on the electrical generating control panel to "TRIP" and releasing it.

(2) Place warning notices in suitable positions to warn personnel that circuit breaker panel 15-216 is open with power on.

(3) Release the quick-release fasteners around the periphery of circuit breaker panel 15-216; then open the panel to the extent necessary to permit access to the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch.

(4) If the switch guard on the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch is tie-locked, sever and remove the tie-locking.

(5) Ensure that duly authorized personnel are positioned as necessary for equipment bay cooling system rectification procedures involving use of the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch.

(6) Ensure that the conditions for the connection of electrical ground power to the main a.c. distribution system are satisfied (Ref. paras.2.B.(1), (2) and (3)).

CAUTION: WHEN THE "EQUIPMENT BAY COOLING GROUND POWER INHIBIT" SWITCH IS SET TO "OVERRIDE", CARE MUST BE TAKEN TO ENSURE THAT THE OVERHEATING OF RACKED EQUIPMENT IS PREVENTED DURING THE TIME THAT EQUIPMENT BAY COOLING IS ABSENT OR INADEQUATE.

(7) Set the ground power control switch to "CLOSE" and release it; then set the EQUIPMENT BAY COOLING INHIBIT switch to "OVERRIDE" within 45 s, and check that the switch toggle is self-maintained in the OVERRIDE position.

(8) Proceed with equipment bay cooling system rectification procedures as necessary.

C. Conclusion

(1) Trip the GPB by setting the ground power control switch on the electrical generating control panel to "TRIP" and releasing it.

(2) Ensure that the toggle of the GROUND POWER INHIBIT switch has returned to, and is guarded at, the NORMAL position.

(3) If tie-locking of the switch guard on the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch is required, lock the guard, using the tie-locking method and material approved by the senior engineer.

NOTE: The switch guard is drilled to provide a locking facility for use at the airline operator's discretion.

(4) Ensure that the area behind circuit breaker panel 15-216 is clean and free from foreign objects.

(5) Close circuit breaker panel 15-216 and secure it with its fasteners.

(6) Remove the warning notices placed in accordance with the requirements of para.B.(2).

EXTERNAL POWER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

This topic contains instructions for the removal and installation of minor electrical components, comprising a ground services isolate contactor and a ground services control switch, and instructions for the renewal of filaments in 'ground power available' and 'ground power not in use' indicator lamps.

Instructions for the removal and installation of Nos.1 and 2 ground/flight change-over contactors, mounted in the flight compartment racking on shelf 12-215 and shelf 12-216, respectively, and the a.c. distribution split system breakers (SSBs) mounted on panels 24-215 and 24-216, are contained in 24-00-00.

The ground services isolate contactor is located at the aft end of the flight compartment RH upper racking on the outboard wall of panel 26-216. The contactor is secured to a mounting plate by bolts, and electrical connections are made to screw-type terminals that are protected by a terminal cover. Access to the contactor is gained by opening circuit breaker panel 25-216 on its hinges.

The GROUND SERVICE control switch is a toggle-type switch mounted on the forward steward's control panel (panel 1-221) in the forward vestibule. The switch is mounted from the rear of the panel, access being gained by lowering the panel on its hinges. Electrical connections to the switch are made to socket-type terminals.

The GROUND POWER indicator lamps, labelled AVAILABLE and NOT IN USE, are situated in the ground power supply plug compartment on a support bracket forward of the ground power supply plug. A 28 V 0.04 A filament is contained in each lamp cap which is in turn screwed into the lamp body. Access to the lamps is gained by opening the ground power supply hinged access panel.

R **ON A/C 006-007,

This topic also contains instructions for the removal and installation of an equipment bay cooling ground power inhibit switch and an associated ground power control relay.

The equipment bay cooling ground power inhibit switch is a toggle-type, magnetically latched, guarded switch mounted

on a bracket assembly which is in turn attached to a tube support in the flight compartment RH upper racking behind circuit breaker panel 15-216, access being gained by opening the panel on its hinges. The switch is equipped with flying leads through which electrical connections are made to socket-type terminals on a module block fitted to the switch mounting bracket.

The ground power control relay is a 45 s fixed time delay relay mounted on one side of a vertical chassis within the RH air relay box, 17-123, in the forward underfloor racking. Direct access to the relay is available through the open side of the relay box. The relay is a plug-in type which is secured to its base by nuts and washers.

2. Ground Services Isolate Contactor (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 4 to 5 lbf in (0.045 to 0.056 mdaN)	-
Torque spanner, 8 to 9 lbf in (0.090 to 0.102 mdaN)	-
Torque spanner, 60 to 70 lbf in (0.690 to 0.800 mdaN)	-

B. Prepare to Remove Contactor

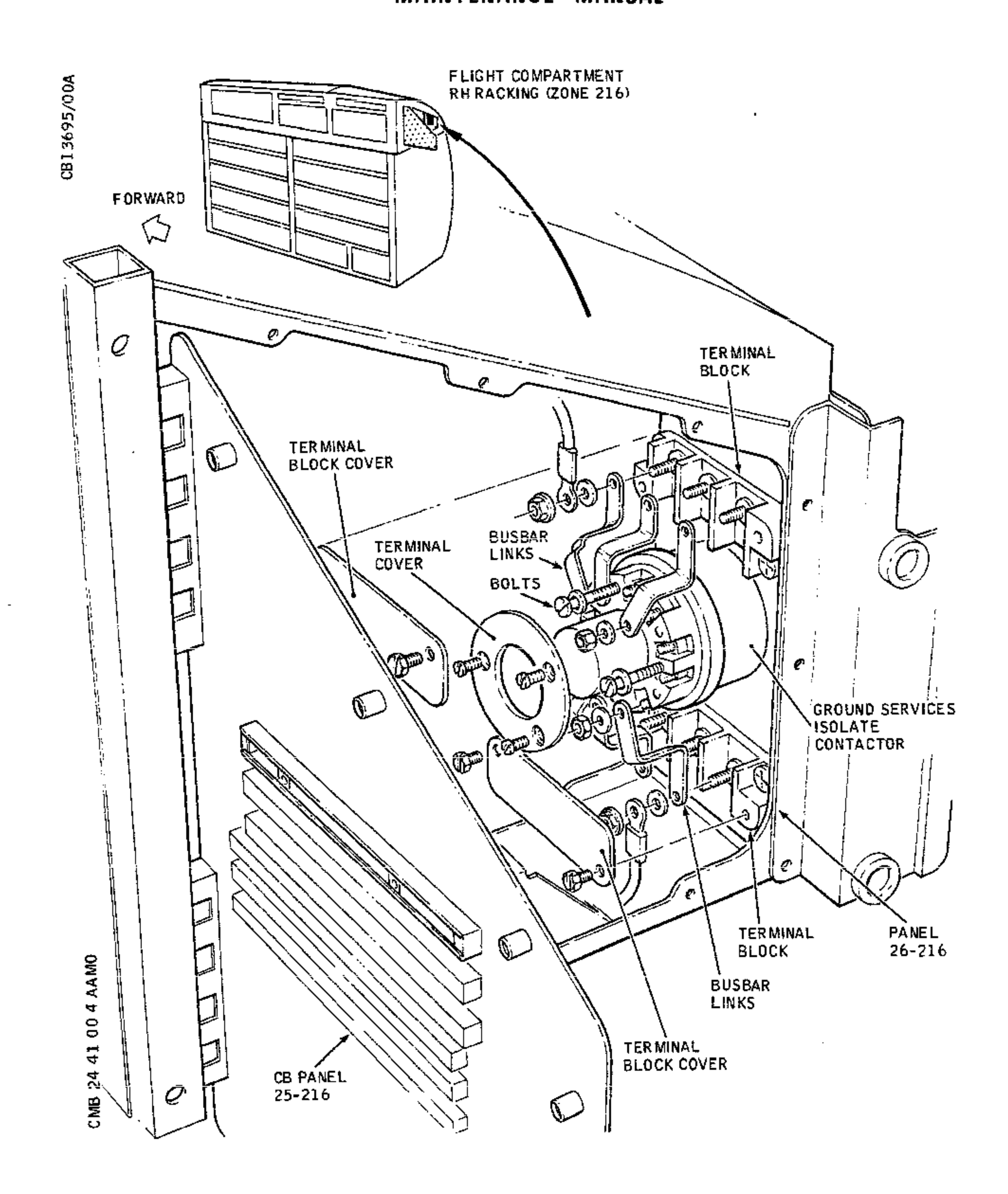
(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Release the quick-release fasteners securing circuit breaker panel 25-216 to the aft end of the flight compartment RH upper racking, and open the panel on its hinges to gain access to the ground services isolate contactor.

C. Remove Contactor

(1) Remove the contactor terminal cover.

(2) Disconnect the electrical cables and the busbar links from the contactor terminals.



- Ground Services Isolate Contactor - Installation
Figure 401

(3) Remove the associated terminal block covers and loosen the busbar link connections at the terminal blocks to assist in the removal of the contactor.

(4) Support the contactor, remove the bolts securing the contactor to the mounting plate and withdraw the contactor from the racking.

D. Install Contactor

(1) Comply with the electrical safety precautions.

(2) Remove the terminal cover from the contactor.

(3) Fit the contactor on the mounting plate and secure it with the bolts.

(4) Connect the electrical cables and the busbar links to the contactor terminals, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(a) Torque-tighten the busbar link connections at the contactor to between 8 and 9 lbf in (0.090 and 0.102 mdaN).

(b) Torque-tighten the electrical cable connections to between 4 and 5 lbf in (0.045 and 0.056 mdaN).

(c) At the terminal block, torque-tighten the connecting nuts to between 60 and 70 lbf in (0.690 and 0.800 mdaN).

(5) Refit the terminal covers to the contactor and to the terminal blocks.

(6) Check that the contactor is bonded in accordance with 20-27-11.

E. Conclusion

(1) Close the circuit breaker panel and secure it with the quick-release fasteners.

(2) Cancel the electrical safety precautions taken before removal, and make available electrical ground power as detailed in 24-41-00.

(3) Check the operation of the ground services isolate contactor by carrying out the appropriate test procedure.

3. GROUND SERVICE Control Switch

A. Prepare to Remove Control Switch

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Release the quick-release fasteners and lower the forward steward's control panel on its hinges.

B. Remove Control Switch

(1) Using a suitable tool, withdraw the pin inserts from the socket-type terminals on the switch.

(2) Remove the nut and washer securing the switch at the front of the panel, and withdraw the switch and tabwasher from the rear.

C. Install Control Switch

(1) Comply with the electrical safety precautions.

(2) Position the tabwasher on the switch and insert the switch through the aperture from the rear of the panel, ensuring that the tab on the tabwasher engages the locating hole in the panel.

(3) Secure the switch with the nut and washer at the front of the panel.

(4) Using a suitable tool, connect the electrical cables to the switch terminals, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

D. Conclusion

(1) Close and secure the forward steward's control panel.

(2) Cancel the electrical safety precautions taken before removal, and make available electrical ground power as detailed in 24-41-00.

(3) Check the operation of the GROUND SERVICE control switch by carrying out the appropriate test procedure.

4. GROUND POWER AVAILABLE and NOT IN USE Indicator Lamps Filament Renewal

A. Prepare to Renew Filament

(1) Isolate the electrical generation and the external power supplies as detailed in 24-00-00, Servicing.

(2) Open the ground power supply hinged access panel to gain access to the GROUND POWER AVAILABLE and NOT IN USE indicator lamps.

B. Renew Filament

(1) Ensure that the appropriate indicator light is out.

(2) Unscrew the indicator lamp cap from the lampholder and remove the cap, complete with filament, from the holder.

(3) Withdraw the filament from the cap and fit a replacement filament.

(4) Screw the lamp cap, together with filament, into the lampholder.

C. Conclusion

(1) Cancel the electrical safety precautions taken before removal and make available electrical ground power as detailed in 24-41-00.

(2) Check that the appropriate filament is lit.

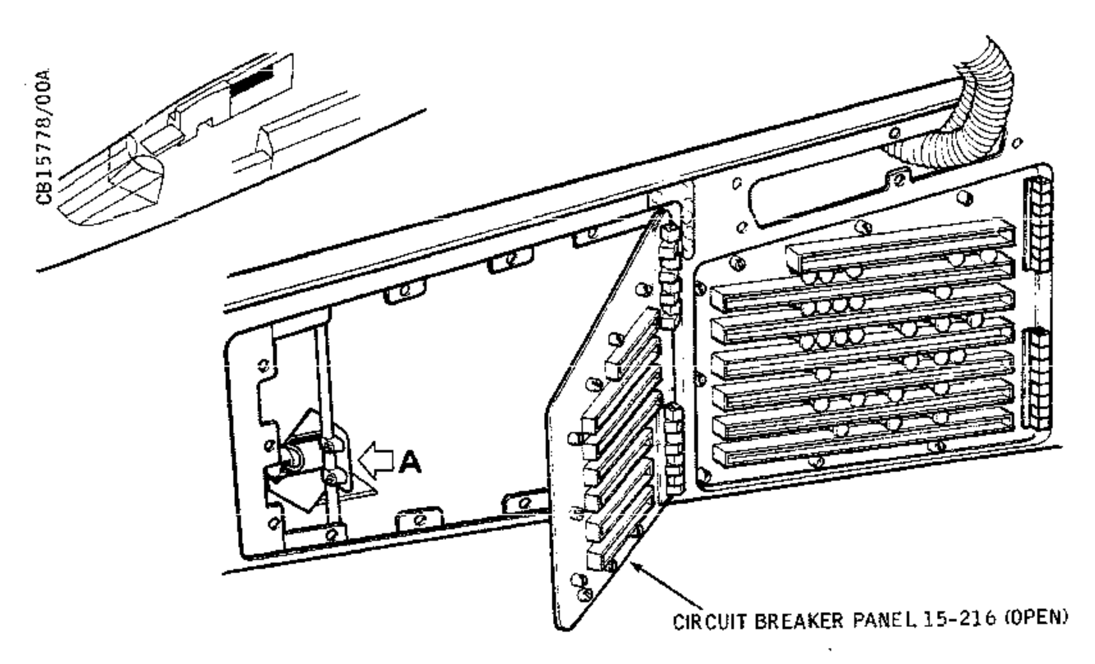
NOTE: The NOT IN USE indicator lamp will be lit only when ground power is available but is switched off at both the ground power control switch and the ground service control switch (Ref. Servicing).

R **ON A/C 006-007,
5. Equipment Bay Cooling Ground Power Inhibit Switch (Ref. Fig. 402)

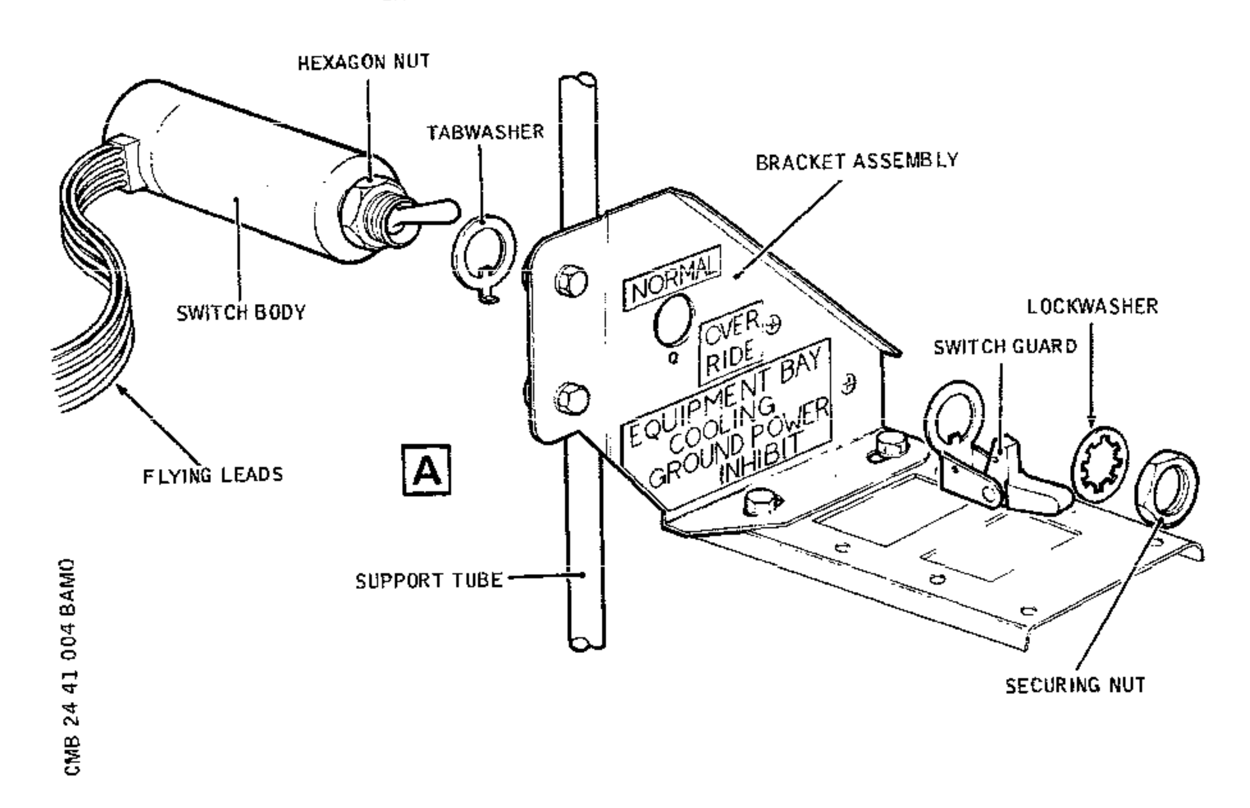
A. Prepare to Remove Inhibit Switch

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Release the quick-release fasteners securing circuit breaker panel 15-216 to the forward end of the flight compartment RH upper racking, and open the panel to its full extent to gain access to the equipment bay cooling ground power inhibit switch.



FLIGHT COMPARTMENT UPPER RACKING - ZONE 216



Equipment Bay Cooling Ground Power Inhibit Switch - Installation
Figure 402

R NOTE: If a new switch is to be fitted, note the
R required length and run of the flying leads
R between the switch and the module block.

B. Remove Inhibit Switch

(1) Using a pin extraction tool, withdraw the pin inserts, at the end of the flying leads, from the module block on the switch mounting bracket.

(2) If applied, disconnect the tie-locking from the switch guard.

(3) Remove the nut and lockwasher securing the switch at the front of the mounting bracket, and withdraw the switch body and tabwasher from the rear, and the switch guard from the front.

C. Install Inhibit Switch

(1) Comply with the electrical safety precautions.

R (2) If a new switch is to be fitted, refer to the note
R under paragraph A.(2). Cut the flying leads to the
R required length, bunch and sleeve them along this
R length with type BAS7857 sleeving of suitable size
R and fit a module block contact to each lead
R (Ref. Wiring Diagram Manual, 20-42-18).

R (3) Position the tabwasher on the switch and insert the switch through the aperture from the rear of the mounting bracket, ensuring that the tab on the tabwasher engages the locating hole in the bracket.

R (4) Assemble the switch guard to the front of the switch. Ensure that the guard is correctly orientated; then secure the switch to the bracket with the nut and lockwasher.

R (5) Using a pin insertion tool, connect the flying
R leads to the module block (Ref. Wiring Diagram
R Manual, 20-42-18), ensuring that the connections
are made in accordance with the cable
identifications and the applicable wiring diagram.
R Ensure that the sleeved leads are correctly run and
R secured to the switch body with the cable tie
R (Ref. Wiring Diagram Manual, 20-41-02).

D. Conclusion

WARNING: SUBSEQUENT PROCEDURES REQUIRE THE TESTING OF 200/115 V AC CONTROL EQUIPMENT WITH POWER APPLIED AND CIRCUIT BREAKER PANEL 15-216 OPEN. PLACE SUITABLE WARNING PLACARDS IN THE AREA AND ENSURE THAT PERSONNEL ARE CLEAR WHILST POWER IS ON.

(1) Cancel the electrical safety precautions taken before removal and make available electrical ground power as detailed in 24-41-00.

(2) Check the operation of the equipment bay cooling ground power inhibit switch by carrying out the appropriate test procedure.

(3) If required, apply tie-locking to the switch guard.

(4) Close the circuit breaker panel and secure it with the quick-release fasteners.

6. Ground Power Control Relay (Ref. Fig. 403)

A. Prepare to Remove Relay

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Open service compartment door 123 BB (Ref. 54-41-11) to gain access to the RH air relay box, 17-123, mounted in the forward underfloor racking.

(3) Release the two fasteners from the relay box hold-down hooks.

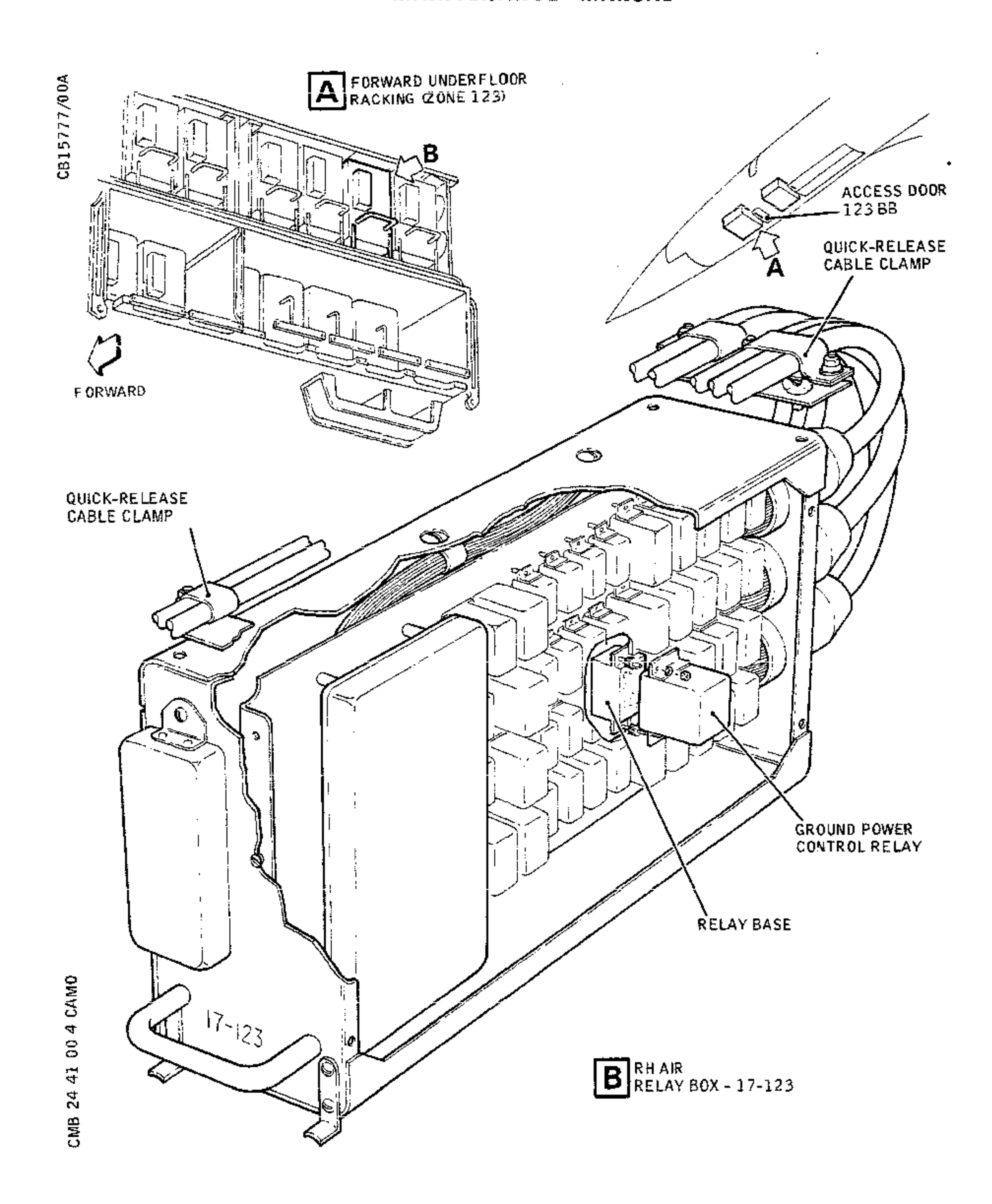
(4) Withdraw the relay box from its mounting rack sufficiently to gain access to the quick-release cable clamps on top of the box. Release the clamps to detach the cables from the box.

(5) Remove the relay box from the mounting rack and place it on a suitable support.

B. Remove Relay

(1) Remove the nuts and washers securing the ground power control relay to its mounting base and withdraw the relay from the socket.

C. Install Relay



- Ground Power Control Relay - Installation
Figure 403

(1) Comply with the electrical safety precautions.

(2) Ensure that the locating pin on the relay body is in alignment with the hole in the relay base and then insert the relay into the socket.

(3) Secure the relay to its base with the nuts and washers.

D. Conclusion

(1) Mount the relay box on the end of the rack support rails and secure the cables to the top of the box with the quick-release cable clamps.

(2) Slide the box into the rack and secure it with the hold-down fasteners.

(3) Check that the relay box is bonded in accordance with 20-27-11.

(4) Cancel the electrical safety precautions taken before removal and make available electrical ground power as detailed in 24-41-00.

(5) Check the operation of the ground power control relay by carrying out the appropriate test procedure.

(6) Close and secure service compartment door 123 BB (Ref. 52-41-11).

EXTERNAL POWER - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

**ON A/C 001-005,

This topic contains the External-power System Test, which is a comprehensive test carried out at major maintenance periods of the aircraft. It is divided, for convenience of application, into a series of tests identified under separate headings as follows:-

Differential Protection Current Transformers

Main Distribution Control

Ground/Flight Busbar Supply Control

The first test checks the integrity of the windings of the differential protection current transformers associated with the ground power protection unit. The second test checks the operation of equipment which effects distribution of the ground power supply to the main a.c. distribution system via the ground power breaker (GPB). The third test checks the operation of the ground services isolation contactor and Nos.1 and 2 ground/flight busbar change-over contactors.

R **ON A/C 006-007,

R This topic contains the External-power System Test, which is a
R comprehensive test carried out at major maintenance periods of
R the aircraft. It is divided, for convenience of application,
R into a series of tests identified under separate sub-headings
R as follows:-

R Differential Protection Current Transformers

R Main Distribution Control

R Ground/Flight Busbar Supply Control
R
R Equipment Bay Cooling Ground Power Inhibit

R The first test checks the integrity of the windings of the
R differential protection current transformers associated with
R the ground power protection unit. The second test checks the

R operation of equipment which effects distribution of the
R ground power supply to the main a.c. distribution system via
R the ground power breaker (GPB). The third test checks the
R operation of the ground services isolation contactor and
R Nos.1 and 2 ground/flight busbar change-over contactors.

R The fourth test checks the operation of equipment which trips
R the GPB automatically in the event of an equipment bay cooling
R failure. It includes a check of the associated control equip-
R ment which permits override of the automatic inhibition of
R ground power, to facilitate the rectification of equipment
R bay cooling faults.

R **ON A/C 001-007,

Operational and Functional Tests are not included since these are satisfied by the procedures laid down for the connection of electrical ground power to the main a.c. and ground services distribution systems (Ref. 24-41-00, Servicing).

2. System Test

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Differential protection current transformers test supply, required for the test in paragraph B., to check the impedance of each winding of the transformer under test. The requirement is for a 6 V 400 Hz single-phase supply limited so that under a fault condition (short-circuit) the current drawn will be approximately 500 mA	-
Precision-grade testmeter, range 0-100 mA, required for the test in paragraph B.	

CAUTION: ENSURE THAT AN APPROVED FORM OF ADAPTER IS USED TO CONNECT ELECTRICAL TEST EQUIPMENT TO THE ELECTRICAL PLUG OR SOCKET CONNECTORS.

NOTE: Certain ground power protection functions, e.g., over-voltage, incorrect phase sequence, differential faults, are dormant and can be safely checked only by appropriate testing of the ground power protection unit at bench level (Ref. Overhaul Manual, 24-40-02). It is therefore recommended that the ground power protection unit be tested accordingly, unless satisfactory operation has been recently proved by routine check of the unit at bench level.

B. Differential Protection Current Transformers

(1) Prepare

(a) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(b) Gain access to the ground power protection unit by removing the appropriate panel from the flight compartment right-hand racking.

(c) Loosen the clamp nut and disconnect the hold-down screw assembly from the ground power protection unit hold-down lug.

(d) Withdraw the ground power protection unit from the junction box and shelf.

(2) Test

(a) Using the differential protection current transformer test supply and the testmeter, check the impedance of each winding of the differential protection current transformer, X19, as follows.

a1) Ensure that the test supply is switched off.

a2) Using a suitable cable link, connect the testmeter in series between one terminal of the test supply and pin 22 of the ground power protection unit connector X20-A in the aircraft rack. Ensure that the testmeter is set to the range 0-100 mA.

a3) Using a suitable cable link, connect the other terminal of the test supply to pin 16 of the connector X20-A, to complete the

test circuit for the phase A winding of the transformer.

a4) Switch on the test supply and check that the indication on the testmeter is 10(+0 -5) mA.

a5) Switch off the test supply. Disconnect the cable link from pin 16 and reconnect it to pin 18 of the connector X20-A to complete the test circuit for the phase B winding of the transformer.

a6) Repeat operation a4).

a7) Switch off the test supply. Disconnect the cable link from pin 18 and reconnect it to pin 20 of the connector X20-A to complete the test circuit for the phase C winding of the transformer.

a8) Repeat operation a4).

a9) Switch off the test supply. Disconnect and remove the test supply and testmeter cable links from pins 22 and 20 of the connector X20-A.

(b) Using the differential protection current transformer test supply and the testmeter, check the impedance of each winding of the differential protection current transformer, X18, as follows:

b1) Ensure that the test supply is switched off.

b2) Using a suitable cable link, connect the testmeter in series between one terminal of the test supply and pin 23 of the ground power protection unit connector X20-A in the aircraft rack. Ensure that the testmeter is set to the range 0-100 mA.

b3) Using a suitable cable link, connect the other terminal of the test supply to pin 15 of the connector X20-A, to complete the test circuit for the phase A winding of the transformer.

b4) Switch on the test supply and check that

the indication on the testmeter is 10(+0 -5) mA.

b5) Switch off the test supply. Disconnect the cable link from pin 15 and reconnect it to pin 17 of the connector X20-A to complete the test circuit for the phase B winding of the transformer.

b6) Repeat operation b4).

b7) Switch off the test supply. Disconnect the cable link from pin 17 and reconnect it to pin 19 of the connector X20-A to complete the test circuit for the phase C winding of the transformer.

b8) Repeat operation b4).

b9) Switch off the test supply. Disconnect and remove the test supply, the testmeter and the cable links.

(3) Conclusion

(a) Place the ground power protection unit on the shelf and slide it back until the hold-down spigot engages in the hold-down hole in the back of the case, and the electrical connector is fully engaged with the mating connector of the shelf junction box.

(b) Engage the hold-down screw assembly with the ground power protection unit hold-down lug and secure the clamp nut. Ensure that the unit is bonded in accordance with 20-27-11.

(c) Refit and secure the access panel.

(d) Cancel the electrical isolation precautions taken in operation (1)(a), i.e., remove the warning notices.

C. Main Distribution Control

(1) Prepare

(a) Isolate the split system breaker (SSB) and bus-tie breaker (BTB) control circuits from the normal (aircraft busbars) 28 V d.c. supply by

tripping the circuit-breakers listed below and fitting safety clips.

SERVICE	PANEL	CIRCUIT BREAKER	MAP REF.
SSB CONT	3-213	X29	F12
No.1 GEN CONT UNIT SUP	1-213	1X4	P7
No.2 GEN CONT UNIT SUP	1-213	2X4	P8
No.3 GEN CONT UNIT SUP	3-213	3X4	E8
No.4 GEN CONT UNIT SUP	3-213	4X4	E9

(b) Connect electrical ground power to the ground services distribution system only (Ref. Servicing, para.2.A). If ground power is already connected to the main a.c. distribution system (GPB closed), set the ground power control switch on the electrical generating control panel to "TRIP" and release it.

(c) Set the GROUND SERVICE control switch to "OFF" and then to "ON" and check that the GROUND POWER NOT IN USE indicator light is lit and then extinguished.

(d) Check that the GRND PWR AVAILABLE caption on the electrical generating control panel is illuminated.

(e) Set the AC FREQ/VOLTS selector switch on the electrical generating control panel to "GRD PWR" and ensure that the correct voltage and frequency (115(\5) V, 400(\4) Hz) are indicated on the a.c. voltmeter and frequency meter.

(f) Set the AC FREQ/VOLTS selector switch, in turn, to "EMERG PWR", "GEN 1", "GEN 2", "GEN 3" and "GEN 4", checking at each setting that the indications on the a.c. voltmeter and the frequency meter are zero.

(g) Repeat operation (e).

(2) Test

(a) On the electrical generating control panel, check that -

a1) the split system breakers (SSB) control switch is at CLOSE and the SSB position magnetic indicator displays in-line,

a2) all four bus-tie breaker (BTB) control switches are at NORM and all four BTB position magnetic indicators display in-line,

a3) all four generator circuit breaker (GCB) position magnetic indicators and the auto shed breaker (ASB) position magnetic indicator display cross-line,

a4) all four essential/main (NORM/EMERG) control switches are at NORM,

a5) all four transformer rectifier unit (TRU) control switches are at NORM, and

a6) both battery control switches are at OFF and the associated 'battery isolate' and 'essential/main split' magnetic indicators display cross-line.

R **ON A/C 001-006,

(b) Set the ground power control switch on the main generating control panel to "CLOSE" and release it. Check that -

b1) the 'essential/main split' magnetic indicators change from cross-line to in-line, and

b2) the captions CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and both BATT ISOLATE captions are illuminated.

R **ON A/C 007-007,

R
R
R (b) Set the ground power control switch on the main generating control panel to "CLOSE" and release it. Check that -

R b1) the 'essential/main split' magnetic indicators change from cross-line to in-line, and

R b2) the captions CSD 1, CSD 2, CSD 3, CSD 4, GEN 1, GEN 2, GEN 3, GEN 4 and the ISOL sections of both BATT - FAIL/ISOL captions are illuminated.

R **ON A/C 001-007,

(c) Check that the GROUND SERVICE control switch on the steward's panel in the forward vestibule is set to ON.

(d) Set BATT A and BATT B control switches to "ON" and check that the associated 'battery isolate' magnetic indicators change from cross-line to in-line.

(e) Set Nos.1, 2, 3 and 4 bus-tie breaker (BTB) control switches, in turn, to "TRIP", checking at each setting that the correspondingly numbered BTB position magnetic indicators display cross-line, and the correspondingly numbered AC MAIN BUS and AC ESS BUS captions are illuminated.

(f) Set Nos.1, 2, 3 and 4 BTB control switches, in turn, to "NORM", checking at each setting that the correspondingly numbered BTB position magnetic indicators change from cross-line to in-line, and the correspondingly numbered AC MAIN BUS and AC ESS BUS captions are extinguished.

(g) Set the ground power control switch to "TRIP", then to "CLOSE" and release, checking that all four AC MAIN BUS captions and all four AC ESS BUS captions are illuminated and then extinguished.

(h) Set the SSB control switch to "OPEN" and then to "CLOSE" and check that the SSB position magnetic indicator displays cross-line and then in-line and that all four AC MAIN BUS captions and all four AC ESS BUS captions are illuminated and then extinguished.

(i) Set the ground power control switch to "TRIP"

and release. Check that all four AC MAIN BUS . and all four AC ESS BUS captions are illuminated.

(j) Switch off the ground power supply at source and check that the GRND PWR AVAILABLE caption is extinguished and that all four BTB position magnetic indicators and the SSB position magnetic indicator change from in-line to cross-line.

(k) Remove the safety clip and reset the SSB CONT circuit breaker X29 on circuit breaker panel 3-213, map ref.F12, and check that the SSB position magnetic indicator changes from cross-line to in-line.

(l) Set the SSB control switch to "OPEN" and then to "CLOSE" and check that the SSB position magnetic indicator changes to cross-line and then back to in-line.

(m) Remove the safety clips and reset the Nos.1, 2, 3 and 4 GEN CONT UNIT SUP circuit-breakers (Ref. para.(1)(a)), in turn, and check that as each is reset, the correspondingly numbered BTB position magnetic indicator changes from cross-line to in-line.

(n) Set Nos.1, 2, 3 and 4 BTB control switches, in turn, to "TRIP" and then to "NORM" and check that the correspondingly numbered BTB position magnetic indicator changes to cross-line and then back to in-line as the appropriate switch selections are made.

(3) Conclusion

(a) Set both battery control switches to "OFF".

(b) If there is a further requirement for ground power, switch on the ground supply at source and check that the GROUND POWER AVAILABLE light comes on and the GRND PWR AVAILABLE caption is illuminated.

(c) If there is no further requirement for ground power -

c1) remove the electrical ground supply connector from the ground supply plug

and disconnect the cable support device from the hook, and

c2) stow the hook in its spring clip in the ground supply plug compartment and shut and secure the hinged access panel.

D. Ground/Flight Busbar Supply Control

(1) Prepare

(a) Connect electrical ground power to the main a.c. distribution system (Ref. Servicing, para.2.B.).

(b) Ensure that interruption of power supplies by operation of the GROUND SERVICE control switch will not interfere with concurrent servicing procedures.

(c) Set the GROUND SERVICE control switch to "OFF".

(2) Test

(a) Test the operation of No.1 ground/flight change-over contactor as follows:-

a1) On the forward steward's control panel (1-221) set the MAIN CABIN - FWD lighting control switch to "MAIN" and the MAIN CABIN - FWD lighting SELECT switch to "FULL", and check that the fluorescent tubes at the roof and at the wall panels in the forward cabin are lit.

a2) Set No.1 BTB control switch to "TRIP" and check that the fluorescent tubes at the roof panels in the forward cabin are extinguished.

a3) Set the GROUND SERVICE control switch to "ON" and then to "OFF" and check that the fluorescent tubes at the roof panels in the forward cabin are lit and then extinguished.

a4) Set No.1 BTB control switch to "NORM" and check that the fluorescent tubes at the roof panels in the forward cabin are lit.

(b) Test the operation of No.2 ground/flight change-over contactor as follows:-

b1) Set No.4 BTB control switch to "TRIP" and check that the fluorescent tubes at the wall panels in the forward cabin are extinguished.

b2) Set the GROUND SERVICE control switch to "ON" and then to "OFF" and check that the fluorescent tubes at the wall panels in the forward cabin are lit and then extinguished.

b3) Set No.4 BTB control switch to "NORM" and check that the fluorescent tubes at the wall panels in the forward cabin are lit.

b4) Set the GROUND SERVICE control switch to "ON".

b5) Set the MAIN CABIN - FWD lighting CONTROL and SELECT switches as required.

(3) Conclusion

(a) Switch off and disconnect electrical ground power (Ref. Servicing, para.3.).

R **ON A/C 006-007,

R E. Equipment Bay Cooling Ground Power Inhibit

R (1) Prepare

R (a) Check that the air conditioning system is set
R for operation in the normal ground state (Ref.
R 21-21-00).

R (b) Connect electrical ground power to the ground
R services distribution system only (Ref.
R Servicing, para.2.A.). If ground power is
R already connected to the main a.c. distribution
R system (GPB closed), set the ground power control
R switch on the electrical generating control panel
R to "TRIP" and release it.

R (c) Place notices in suitable positions to warn that
R circuit-breaker panel 15-216 is open with power
R on.

R WARNING: THE "EQUIPMENT BAY COOLING GROUND POWER

INHIBIT" SWITCH IS LOCATED IN PROXIMITY TO ELECTRICAL EQUIPMENT WHICH IS 'LIVE' WHEN POWER SUPPLIES ARE CONNECTED TO THE MAIN A.C. DISTRIBUTION SYSTEM.

(d) Release the quick-release fasteners around the periphery of circuit-breaker panel 15-216; then open the panel to the extent necessary to permit access to the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch.

(e) If the switch guard on the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch is tie-locked, sever and remove the locking tie.

(f) Ensure that the conditions for the connection of electrical ground power to the main a.c. distribution system are satisfied (Ref. Servicing, para.2.B.).

(g) On the equipment bay cooling panel, set the FWD EXTRACT, FAN 2, and FANS 1 & 3 control switches to "OFF".

(h) On the equipment bay cooling panel, set the REAR EXTRACT LH, RH and STANDBY fan control switches to "OFF".

(2) Test

CAUTION: WHEN THE "EQUIPMENT BAY COOLING GROUND POWER INHIBIT" SWITCH IS SET TO "OVER-RIDE", ENSURE THAT THE OVERHEATING OF RACKED EQUIPMENT IS PREVENTED DURING THE TIME THAT EQUIPMENT BAY COOLING IS ABSENT OR INADEQUATE.

(a) Set the ground power control switch to "CLOSE" and release it; then set the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch to "OVERRIDE" within 45 s, and check that the switch toggle is self-maintained in the OVERRIDE position. Check that -

a1) after approximately 6 s, the ground call horn sounds, and

a2) after 1 min, the GPB remains closed, i.e., the ground power supply is still connected to the main a.c. distribution system.

(b) On the equipment bay cooling panel, set the REAR

EXTRACT LH and RH fan control switches to "ON". Check that -

b1) the REAR EXTRACT FLOW caption is extinguished, and

b2) the ground call horn continues to sound.

(c) On the equipment bay cooling panel, set the FWD EXTRACT FAN 2 and FANS 1 & 3 switches to "AUTO". Check that -

c1) both FWD EXTRACT FLOW captions are extinguished,

c2) the ground call horn ceases to sound, and

c3) the toggle of the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch has automatically returned to the NORMAL position.

(d) On the equipment bay cooling panel, set the REAR EXTRACT LH and RH fan control switches to "OFF". Check that -

d1) after approximately 6 s, the ground call horn sounds, and

d2) after approximately 45 s, the GPB is tripped, i.e., the ground power supply is disconnected from the main a.c. distribution system.

(e) On the equipment bay cooling panel, set the REAR EXTRACT LH and RH fan control switches to "ON", ensuring that all switches on the panel are now set for the normal ground state.

(f) Set the ground power control switch to "CLOSE" and release it. Check that, after 1 min, the GPB remains closed, i.e., the ground power supply remains connected to the main a.c. distribution system.

(3) Conclusion

(a) Set the ground power control switch to "TRIP" and release it.

(b) Ensure that the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch is guarded at the NORMAL position.

R (c) If tie-locking of the switch guard on the EQUIPMENT BAY COOLING GROUND POWER INHIBIT switch is required, lock the guard, using the tie-locking method and material approved by the senior engineer.

R NOTE: The switch guard is drilled to provide a locking facility for use at the airline operator's discretion.

R (d) Ensure that the area behind circuit breaker panel 15-216 is clean and free from foreign objects.

R (e) Close circuit breaker panel 15-216 and secure it with its fasteners.

R (f) Remove the warning notices placed in accordance with the requirements of paragraph (1)(c).

R (g) Switch off and disconnect electrical ground power (Ref. Servicing, para.3.).

GROUND POWER PROTECTION UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The ground power protection unit is contained within a 0.25 ATR short case mounted in the flight compartment right-hand racking on shelf 1-216. The unit is clamped to the shelf by a hold-down screw assembly at the front and a hold-down spigot at the rear. A handle on the front of the case facilitates the removal and installation of the unit. Electrical connections are made at a shelf backplate junction box.

2. Ground Power Protection Unit

A. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

B. Remove

(1) Gain access to the ground power protection unit by removing the appropriate panel from the flight compartment right-hand racking.

(2) Loosen the clamp nut and disconnect the hold-down screw assembly from the ground power protection unit hold-down lug.

(3) Withdraw the ground power protection unit from the junction box and shelf.

RB (4) Examine rack and unit connectors for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket
RB contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts
RB and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

C. Install

(1) Comply with the electrical safety precautions.

RB (2) Examine unit connector for:

RB (a) Bent, damaged or corroded contact pins.

RB (b) Distorted, displaced or blackened socket contacts.

RB (c) Pierced, or otherwise damaged dielectric.

RB (d) Connector body free from damaged polarising posts
RB and keyways.

RB NOTE: If connector is damaged refer to WDM 20-42-71.

(3) Place the ground power protection unit on the shelf and slide it back until the hold-down spigot engages in the hold-down hole in the back of the case, and the electrical connector is fully engaged with the mating connector of the shelf junction box.

(4) Engage the hold-down screw assembly with the ground power protection unit hold-down lug and secure the clamp nut. Ensure that the unit is bonded in accordance with 20-27-11.

(5) Fit and secure the panel to the racking.

(6) Make available electrical ground power as detailed in 24-41-00, and ensure that the ground power supply is satisfactorily connected to the main a.c. and ground services distribution systems.

(7) Switch off and disconnect electrical ground power as detailed in 24-41-00.

600 VA TRANSFORMER - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Two 600 VA transformers are associated with the external power system. One transformer is mounted in the flight compartment right-hand racking on shelf 12-216 and supplies the ground power services 28 V a.c. busbar; the other is mounted on the ground power panel, 10-123, in the forward underfloor racking and supplies the ground service lights 28 V a.c. busbar. Each transformer is secured by four screws and electrical connections are made at terminals on top of each transformer case.

The transformer cover (guard) is not supplied by the transformer manufacturer. The screws and washers that secure the transformer guard and terminal cover replace the terminal cover securing screws fitted by the transformer manufacturer.

2. 600 VA Transformer - Shelf 12-216 (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 40 to 45 lbf in (0.452 to 0.509 mdaN)	-
Torque spanner, 38 to 40 lbf in (0.43 to 0.46 mdaN)	-
Torque spanner, 23 to 25 lbf in (0.26 to 0.28 mdaN)	-

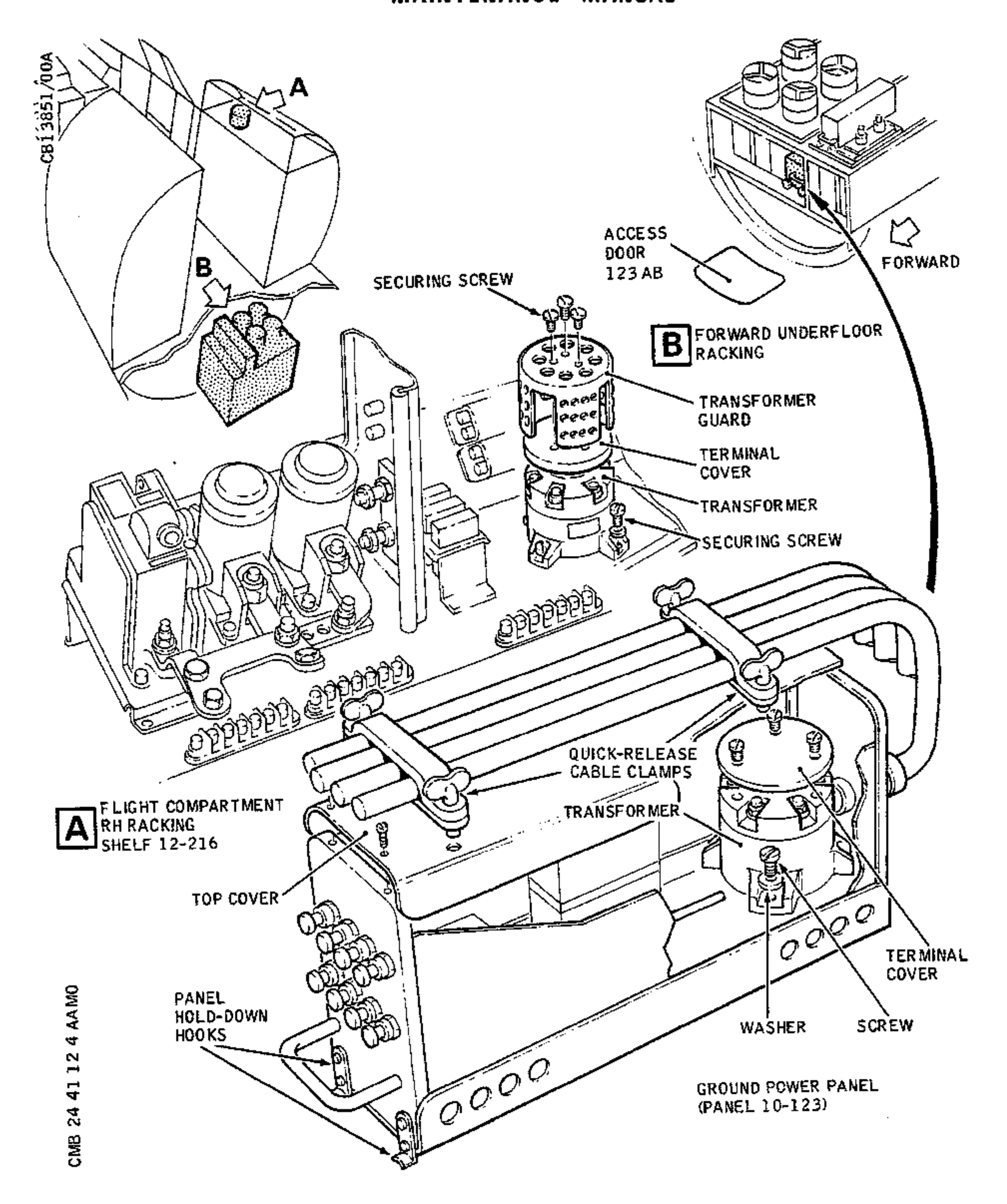
B. Prepare to Remove Transformer from Shelf 12-216

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Gain access to the transformer by opening the appropriate circuit breaker panel on the flight compartment right-hand racking (Ref. 24-50-00).

C. Remove Transformer from Shelf 12-216

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600 VA Transformer - Installation
Figure 401

(1) Remove the transformer guard securing screws and washers. Withdraw the guard and the terminal cover. Retain the screws, washers and guard for use with a replacement transformer.

(2) Disconnect the cables from the transformer terminals.

(3) Remove the screws and washers securing the transformer to the panel and withdraw the transformer.

D. Install Transformer on Shelf 12-216

(1) Comply with the electrical safety precautions.

(2) Remove the securing screws, washers and the terminal cover from the replacement transformer; retain the terminal cover. Use the screws and washers from the replacement transformer to secure the original terminal cover to the removed transformer.

(3) Position the transformer mounting feet over the screw holes in the panel and orientate the transformer with terminal A2 forward and terminal A1 outboard. Secure the transformer with the screws and washers. Torque-tighten the screws to between 40 and 45 lbf in (0.452 and 0.509 mdaN). Check the electrical bonding in accordance with 20-27-11.

(4) Connect the cables to the transformer terminals in accordance with the cable identification and the applicable wiring diagram. Torque-tighten the terminal nuts as follows:-

(a) On 10-32 UNF terminal studs: to between 38 and 40 lbf in (0.43 and 0.46 mdaN).

(b) On 8-32 UNF terminal studs: to between 23 and 25 lbf in (0.26 and 0.28 mdaN).

(5) Fit the terminal cover and the transformer guard and secure them with the screws and washers. Lock the screws in accordance with 20-25-11.

E. Conclusion

(1) Close and secure the circuit breaker panel opened in operation B.(2).

(2) Cancel the electrical safety precautions taken in operation B.(1).

(3) Make available electrical ground power as detailed in 24-41-00.

(4) Set the BOARDING lights switch on the forward steward's panel (Ref. 33-23-00) to "ON" and check that the forward vestibule boarding lamps are lit. Set the switch to "OFF".

(5) Switch off and disconnect electrical ground power as detailed in 24-41-00.

3. 600 VA Transformer - Panel 10-123 (Ref. Fig. 401)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 40 to 45 lbf in (0.452 to 0.509 mdaN)	-
Torque spanner, 38 to 40 lbf in (0.43 to 0.46 mdaN)	-
Torque spanner, 23 to 25 lbf in (0.26 to 0.28 mdaN)	-

B. Prepare to Remove Transformer from Panel 10-123

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Gain access to panel 10-123, mounted in the forward underfloor racking, by opening access door 123 AB (Ref. 52-41-11).

C. Remove Transformer from Panel 10-123 (Ref. Fig. 401)

(1) Loosen the two clamp nuts and disconnect the locking screw assemblies from the panel hold-down hooks.

(2) Withdraw the panel from the rack sufficiently to gain access to the quick-release cable clamps on the panel top cover.

(3) Release the cable clamps and remove the clamped cables from the top cover.

(4) Withdraw the panel from the rack and support it at

the full extent of the electrical cables.

(5) Remove the screws securing the top cover to the panel chassis and remove the cover.

(6) Remove the transformer terminal cover and disconnect the cables from the terminals.

(7) Refit the terminal cover.

(8) Support the transformer, remove the four securing screws and washers and lift the transformer from the panel.

D. Install Transformer in Panel 10-123

(1) Comply with the electrical safety precautions.

(2) Position the transformer in the panel and secure it with the screws and washers. Torque-tighten the screws to between 40 and 45 lbf in (0.452 and 0.509 mdaN). Check the electrical bonding in accordance with 20-27-11.

(3) Remove the transformer terminal cover.

(4) Connect the cables to the transformer terminals in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminal nuts as follows:-

(a) On 10-32 UNF terminal studs: to between 38 and 40 lbf in (0.43 and 0.46 mdaN).

(b) On 8-32 UNF terminal studs: to between 23 and 25 lbf in (0.26 and 0.28 mdaN).

(5) Refit the transformer terminal cover.

(6) Fit the top cover to the panel and secure it with the screws.

(7) Mount the panel on the end of the rack support rails and secure the cables to the top cover with the quick-release cable clamps.

(8) Slide the panel into the racking and secure it with the hold-down fasteners.

(9) Check that the panel is bonded in accordance with 20-27-11.

E. Conclusion

(1) Close and secure access door 123 AB (Ref. 52-41-11).

(2) Cancel the electrical safety precautions taken in operation B.(1).

(3) Make available electrical ground power as detailed in 24-41-00.

(4) Set the GROUND LIGHTING switch on the oxygen panel 20-215 to "ON" (Ref. 33-32-00) and check that the service lamps are lit. Set the switch to "OFF".

(5) Switch off and disconnect electrical ground power as detailed in 24-41-00.

GROUND SUPPLY PLUG REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The ground supply plug is located in the right-hand side of the nosewheel bay, between frames 19 and 20, near the front bulkhead. A hinged panel in the fuselage skin provides access for connecting the external power supply cable.

2. Ground Supply Plug

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 19 to 21 lbf in (0.21 to 0.24 mdaN)	-
Torque spanner, 30 to 35 lbf in (0.34 to 0.39 mdaN)	-
Torque spanner, 76 to 84 lbf in (0.86 to 0.95 mdaN)	-
R R Torque spanner, 240 to 265 lbf in (2.71 to 2.99 mdaN)	-

B. Prepare

(1) Gain access to the nosewheel bay as detailed in 32-22-11, Removal/Installation.

(2) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

C. Remove

(1) Remove the bolts and washers securing the cover over the plug and withdraw the cover.

R (2) Release the clip securing the power supply cables to
R the ground supply plug mounting structure.

R (3) Remove the cables from the three-way heavy duty terminal block. Note the order of assembly of the

cable ends on the terminal posts to ensure correct replacement.

R (4) Release the phase A, B and C busbars from the ground supply plug and lift the busbars from the terminal block and plug.

R (5) Remove the cables from the smaller 'early break' pins on the plug.

R (6) Remove the nut and washer from the N pin on the plug.

R (7) Remove the screws securing the one-way heavy duty terminal block to the structure and lift terminal block and N busbar clear of the plug.

R (8) Hold a box spanner on the nuts, through the external access door, and remove the four corner screws securing the plug to the structure.

R (9) Support the plug pin shroud, through the external access door, and remove the four screws securing the
R plug in the shroud. Collect the shroud and lift the plug out of its cut-out.

D. Install

(1) Comply with the electrical safety precautions.

(2) Insert the plug into its cut-out, pins downward, with the two smaller pins nearest the aft inboard corner. Place the shroud over the pins, through the external access door, and secure it with four screws, through the middle hole in each edge, into the shroud.

(3) Fit the four corner screws and torque-tighten the nuts to between 30 and 35 lbf in (0.34 and 0.39 mdaN). Ensure that the plug is bonded in accordance with 20-27-11.

(4) Place the N busbar, with the terminal block attached, on the N pin at the aft outboard corner of the plug and secure the terminal block to the structure with the screws and washers.

(5) Connect the electrical cables to the smaller 'early break' pins (E and F), ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the nuts to between 19 and 21 lbf in (0.21 and 0.24 mdaN).

CAUTION: THE ASSEMBLY ORDER OF BUSBAR/CABLES TO A TERMINAL POST MUST BE BUSBAR FIRST, IF FITTED, FOLLOWED BY CABLES IN SIZE ORDER WITH THE LARGEST CABLE FIRST.

(6) Connect the phase A, B and C busbars to their respective pins on the plug and three-way heavy duty terminal block. If necessary, slacken the two screws and nuts securing the heavy duty terminal block to achieve even busbar clearance at ground supply plug insulation barriers.

(7) Secure the busbars to the plug pins with nuts and washers. If released, tighten the two screws and nuts securing the heavy duty terminal block.

(8) Torque-tighten the plug pin nuts on busbars A, B, C and N to between 76 and 84 lbf in (0.86 and 0.95 mdaN).

(9) Connect the cables to the terminal posts on the heavy duty terminal block, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram.

(10) Torque-tighten the terminal nuts on the heavy duty terminal block to between 240 and 265 lbf in (2.71 and 2.99 mdaN).

(11) Fit the cover over the ground supply plug and secure it with the bolts and washers.

E. Conclusion

(1) Make available electrical ground power as detailed in 24-41-00.

NOTE: This operation proves correct installation of the ground supply plug.

(2) Close the nosewheel bay doors as detailed in 32-22-11, Removal/Installation.

(3) Switch off and disconnect electrical ground power as detailed in 24-41-00.

DIFFERENTIAL PROTECTION CURRENT TRANSFORMERS - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Two differential protection current transformers (CTUs) are used in the ground power circuit. One CTU is located in the flight compartment RH racking, midway up the outboard half of panel 24-216. The other CTU is located in the right-hand side of the nosewheel bay, near the front bulkhead.

2. Differential Protection Current Transformer (Panel 24-216)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 119 to 131 lbf in (1.38 to 1.48 mdaN)	-
Torque spanner, 240 to 265 lbf in (2.71 to 2.99 mdaN)	-

B. Prepare (Panel 24-216)

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

R (2) Gain access to panel 24-216 by removing the furnishing
R equipment as detailed in Chapter 25.

C. Remove (Panel 24-216)

(1) Disconnect the electrical connector from the transformer.

(2) Disconnect and remove the feeder cables from the ground power breaker (GPB) above the transformer.

NOTE: Note the order of assembly of the cable ends on the terminal posts to ensure correct installation.

(3) Remove the screws and washers securing the transformer and withdraw it over the ends of the feeder cables.

D. Install (Panel 24-216)

(1) Comply with the electrical safety precautions.

(2) Holding the transformer over the ends of the feeder cables, T2 side down and phase A duct outboard, insert the feeder cables (phases A, B, and C) in their respective core holes (phases A, B and C).

(3) Slide the transformer down the feeder cables on to its base and secure it with the screws and washers.

(4) Check that the transformer orientation and cable routing are in accordance with the applicable wiring diagram. Check that the transformer is bonded in accordance with 20-27-11.

CAUTION: CONTACTORS ARE NORMALLY SUPPLIED WITH ONE THICK WASHER, ONE THIN WASHER AND A SPRING WASHER TO EACH TERMINAL POST. THE SPRING WASHER MUST BE PLACED DIRECTLY UNDER THE TERMINAL NUT AND THE THIN WASHER UNDER THE SPRING WASHER. THE THICK WASHER IS NOT REQUIRED.

THE ASSEMBLY ORDER OF BUSBAR/CABLES TO A CONTACTOR TERMINAL POST MUST BE BUSBAR FIRST, IF FITTED, FOLLOWED BY CABLES IN SIZE ORDER WITH THE LARGEST CABLE FIRST.

(5) Connect the feeder cables to the terminals on the GPB in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminal nuts to between 119 and 131 lbf in (1.35 and 1.48 mdaN).

(6) Connect the electrical connector to the transformer.

E. Conclusion

R (1) Fit the furnishing equipment over panel 24-216 as
R detailed in Chapter 25.

(2) Cancel the electrical safety precautions taken in operation B.(1).

(3) Make available electrical ground power as detailed in 24-41-00, and ensure that the ground supply is satisfactorily connected to the main a.c. and ground services distribution systems.

NOTE: A total aircraft load of not less than 20 kVA is necessary to prove satisfactory operation of the transformer in the associated control and protection circuits.

(4) Switch off and disconnect electrical ground power as detailed in 24-41-00.

3. Differential Protection Current Transformer (Nosewheel Bay)

A. Equipment and Materials

DESCRIPTION	PART NO.
Torque spanner, 119 to 131 lbf in (1.38 to 1.48 mdaN)	-
Torque spanner, 240 to 265 lbf in (2.71 to 2.99 mdaN)	-

B. Prepare (Nosewheel Bay)

(1) Gain access to the nosewheel bay as detailed in 32-22-11, Removal/Installation.

(2) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

C. Remove (Nosewheel Bay)

(1) Disconnect the electrical connector from the transformer.

(2) Note the position at which the cable clip is secured, then remove the four bolts and washers securing the transformer cover and the cable clamps on each side of the transformer. Withdraw the cover and the removable halves of the cable clamps.

(3) Disconnect the feeder cables through the transformer at the terminal block at the ground supply plug.

NOTE: Note the order of assembly of the cable ends on the terminal posts to ensure correct installation.

(4) Remove the screws and washers securing the transformer and withdraw it over the ends of the cables.

D. Install (Nosewheel Bay)

(1) Comply with the electrical safety precautions.

(2) Holding the transformer, base upward and T1 side facing aft with phase A core hole outboard, pass the feeder cables (phases A, B and C) through their respective core holes (phases A, B and C).

(3) Slide the transformer along the cables on to its base and secure it with the screws and washers.

(4) Check that the transformer orientation and cable routing are in accordance with the applicable wiring diagram. Check that the transformer is bonded in accordance with 20-27-11.

CAUTION: THE ASSEMBLY ORDER OF BUSBAR/CABLES TO A TERMINAL POST MUST BE BUSBAR FIRST, IF FITTED, FOLLOWED BY CABLES IN SIZE ORDER WITH THE LARGEST CABLE FIRST.

R (5) Connect the feeder cables to the terminal block, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminals to between 240 and 265 lbf in (2.71 and 2.99 mdaN).

(6) Fit the two halves of the cable clamps and the transformer cover, and secure them with the bolts and
R washers, ensuring that the cable clip is secured at
R the correct position.

(7) Connect the electrical connector to the transformer.

D. Conclusion

R (1) Cancel the electrical safety precautions taken in
R operation B.(2).

R (2) Make available electrical ground power as detailed
R in 24-41-00, and ensure that the ground power supply
R is satisfactorily connected to the main a.c. and
R ground services distribution systems.

R NOTE: A total aircraft load of not less than 20 kVA
R is necessary to prove satisfactory operation
R of the transformer in the associated control
R and protection circuits.

R (3) Close the nosewheel bay doors as detailed in 32-32-11,

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Removal/Installation.

R (4) Switch off and disconnect electrical ground power as
R detailed in 24-41-00.

ELECTRICAL LOAD DISTRIBUTION - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

BEFORE THE OPENING OR REMOVAL OF ANY CIRCUIT BREAKER PANEL, THE ELECTRICAL GENERATION AND EXTERNAL POWER SUPPLIES MUST BE ISOLATED AS DETAILED IN 24-00-00, SERVICING.

1. General

This topic contains removal/installation procedures applicable to the circuit breakers located on panels mounted on the flight compartment racking in zones 215 and 216 and on the flight compartment circuit breaker panels in zone 213. It also contains removal/installation procedures applicable to the neon indicators located on the inner face of circuit breaker panels in zone 213.

Panels 21 and 22 in zone 215, and panels 21 and 22 in zone 216, are secured to the rack by quick-release fasteners around the periphery. Releasing the fasteners allows the panel to be removed from the rack to the extent of the cables.

Panel 23 in zone 215 is secured to the rack by retaining screws; removal of the screws permits the panel to be removed from the rack to the extent of the cables.
R Panels 1, 2, 3, 4 and 5 in zone 213, and panels 13, 14 and 15
R in zones 215 and 216, are hinge-mounted and secured to the rack
R by quick-release fasteners around the periphery; the panels
R in zone 213 are hinged at the bottom edge of the panel
R and are fitted with tie cords. Releasing the fasteners allows
R the panels to be opened outward from the rack to the extent
R of the cables or tie cords.
Panels 16-215 and 16-216 are part of the rack structure and are not removable.

There are three types of circuit breaker - single-pole, located by a dowel in the body and secured to the panel by a single central nut and washer, three-pole, secured by six self-locking screws, and three-pole, of similar construction to the single-pole type, but with the necessary extra terminal lugs. Electrical connections to the circuit breaker terminal lugs are made by round-head screws and lockwashers.

Neon warning indicators are fitted on the rear of panels 2 and 4 in zone 213. Releasing the quick-release fasteners around the periphery allows the panels to be opened outward to gain access to the indicators.

2. Circuit Breaker (Ref. Fig.401 and 402)

NOTE: The following removal and installation procedures apply to all three types of circuit breaker.

A. Equipment and Materials

DESCRIPTION	PART NO.
8 UNF offset torque driver, 8 to 10 lbf in (0.090 to 0.11 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

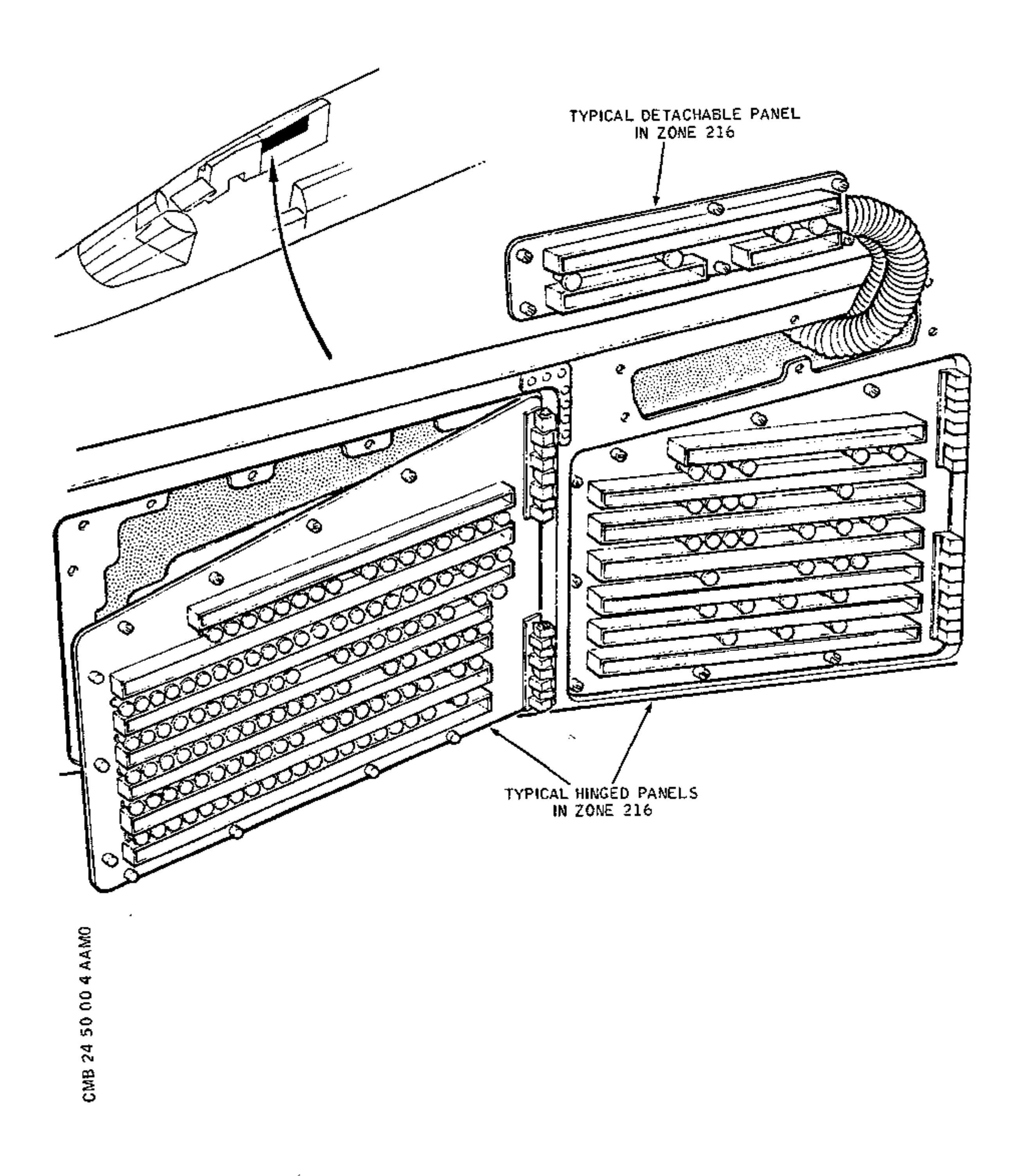
(2) Ensure that BATT A and BATT B control switches are at the OFF position. For circuit breakers mounted on panel 16-215 or 16-216, disconnect the aircraft batteries (Ref.24-31-11).

(3) Release the quick-release fasteners around the periphery of the panel. Open out the panel on the hinge, or withdraw the panel from the rack, as appropriate. To gain access to circuit breakers on panels 13, 14 and 15 in zones 215 and 216, remove the deflector cover (secured by retaining screws). Access to circuit breakers on panels 16-215 and 16-216 is achieved by opening the adjacent panel.

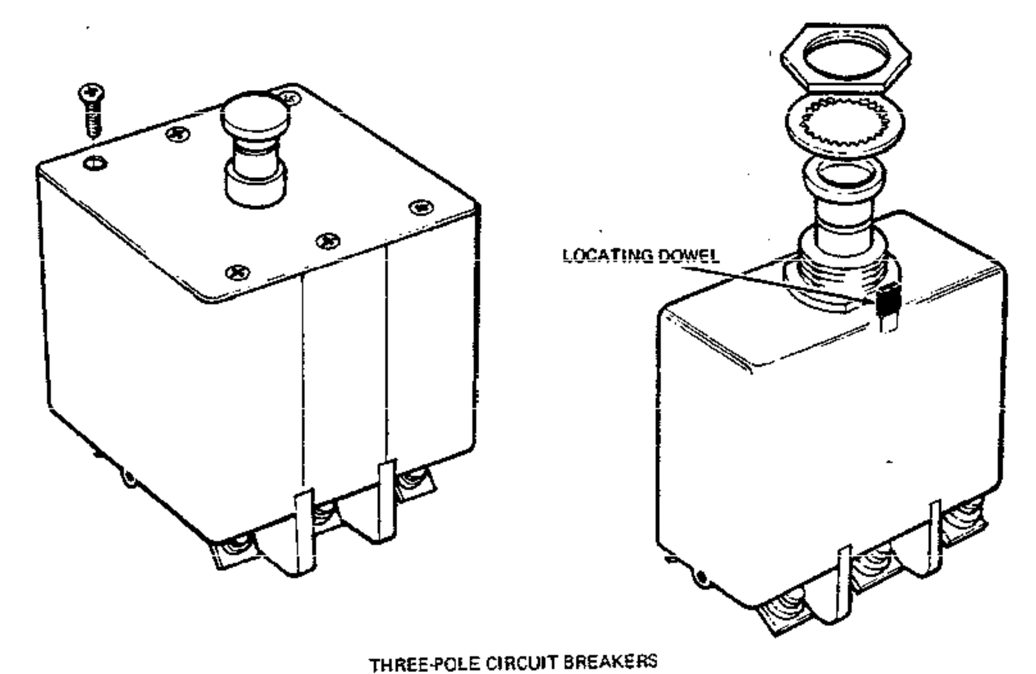
C. Remove

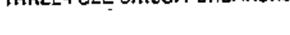
CAUTION: EXCESSIVE MOVEMENT OF CONNECTING LUGS ATTACHED TO THE CIRCUIT BREAKER LINKING BUSBAR MUST BE AVOIDED. MOVEMENT MUST BE THE MINIMUM NECESSARY TO PERMIT REMOVAL OF THE CIRCUIT BREAKER. IF A LARGE AMOUNT OF MOVEMENT IS NECESSARY TO ENABLE THE CIRCUIT BREAKER TO BE REMOVED, THE COMPLETE LINKING BUSBAR MUST BE DISCONNECTED.

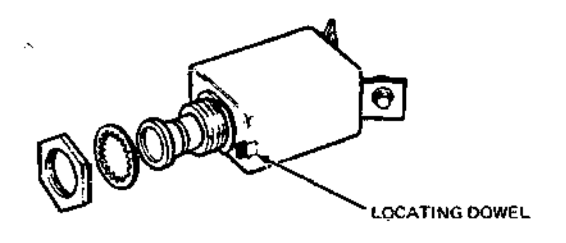
(1) Disconnect the electrical cable/busbar connectors secured by screw and washer to the circuit breaker terminal lugs. Move the busbar connecting lug sufficiently to allow removal of the circuit breaker.



Typical Circuit Breaker Panels
Figure 401







TYPICAL SINGLE-POLE CIRCUIT BREAKER

CMB 24 50 00 4 BAM0

Typical Circuit Breakers
Figure 402

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(2) Remove the central nut and washer or the six self-locking screws, as appropriate, securing the circuit breaker to the panel and withdraw the circuit breaker from its mounting.

D. Install

(1) Comply with the electrical safety precautions.

(2) Place the circuit breaker in position on the panel. When fitting a circuit breaker secured by a central nut and washer, ensure that the locating dowel is correctly engaged.

(3) Secure the circuit breaker to the panel with the central nut and shake-proof washer, or the six mounting screws, as applicable.

(4) Connect the electrical cable/busbar connecting lugs to the circuit breaker terminal lugs with securing screws and shake-proof washers, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminal screws of the circuit breakers to between 8 and 10 lbf in (0.090 and 0.11 mdaN).

(5) Where applicable, refit the deflector cover and secure it with the screws.

(6) Refit or close the circuit breaker panel and secure it to the rack with the fasteners. When closing a panel fitted with a tie cord, ensure that the cord is not trapped at the panel edge.

E. Conclusion

(1) If applicable, reconnect the aircraft batteries (Ref. 24-31-11).

(2) Cancel the electrical safety precautions taken before removal, i.e., remove warning placards, and make available electrical ground power as detailed in 24-41-00.

(3) Check the circuit breaker by carrying out the appropriate test procedures.

3. <u>Neon Indicator</u>

A. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00.

(2) Ensure that the BATT A and BATT B control switches are at the OFF position.

(3) Gain access to the neon indicators on circuit breaker panels 2-213 and 4-213 by releasing the quick-release fasteners around the periphery of the panel. Open the panel outward on the hinge.

B. Remove

(1) Unscrew the neon indicator knob to release it from the holder, and withdraw the neon lamp from the knob.

C. Install

(1) Comply with the electrical safety precautions.

(2) Insert a replacement neon lamp into the indicator knob, and screw the knob into the holder until it is fully engaged.

D. Conclusion

(1) Cancel the electrical safety precautions taken before removal, i.e., remove warning placards, and make available electrical ground power as detailed in 24-41-00.

(2) Check that the neon indicators are lit.

(3) Switch off and disconnect the electrical ground power as detailed in 24-41-00.

(4) Close the circuit breaker panel and secure it to the rack with the fasteners.

AC DISTRIBUTION - DESCRIPTION AND OPERATION

1. General (Ref. Fig.001 and 002)

200/115 V three-phase 400 Hz a.c. power from each of the four generating channels (Nos.1, 2, 3 and 4) is distributed through four correspondingly numbered three-phase main a.c. busbars.

In each channel, the generator is connected to the correspondingly numbered main a.c. busbar by a generator circuit breaker (GCB), each main busbar being connected to one of four three-phase essential a.c. busbars by a change-over contactor. Nos.1 and 2 main busbars are interconnected by two bus-tie breakers (BTBs) to form sub-system 'A' and Nos.3 and 4 main busbars are similarly interconnected by two further BTBs to form sub-system 'B', the bus-tie bars of the two generating sub-systems being interconnected by two split system breakers (SSBs).

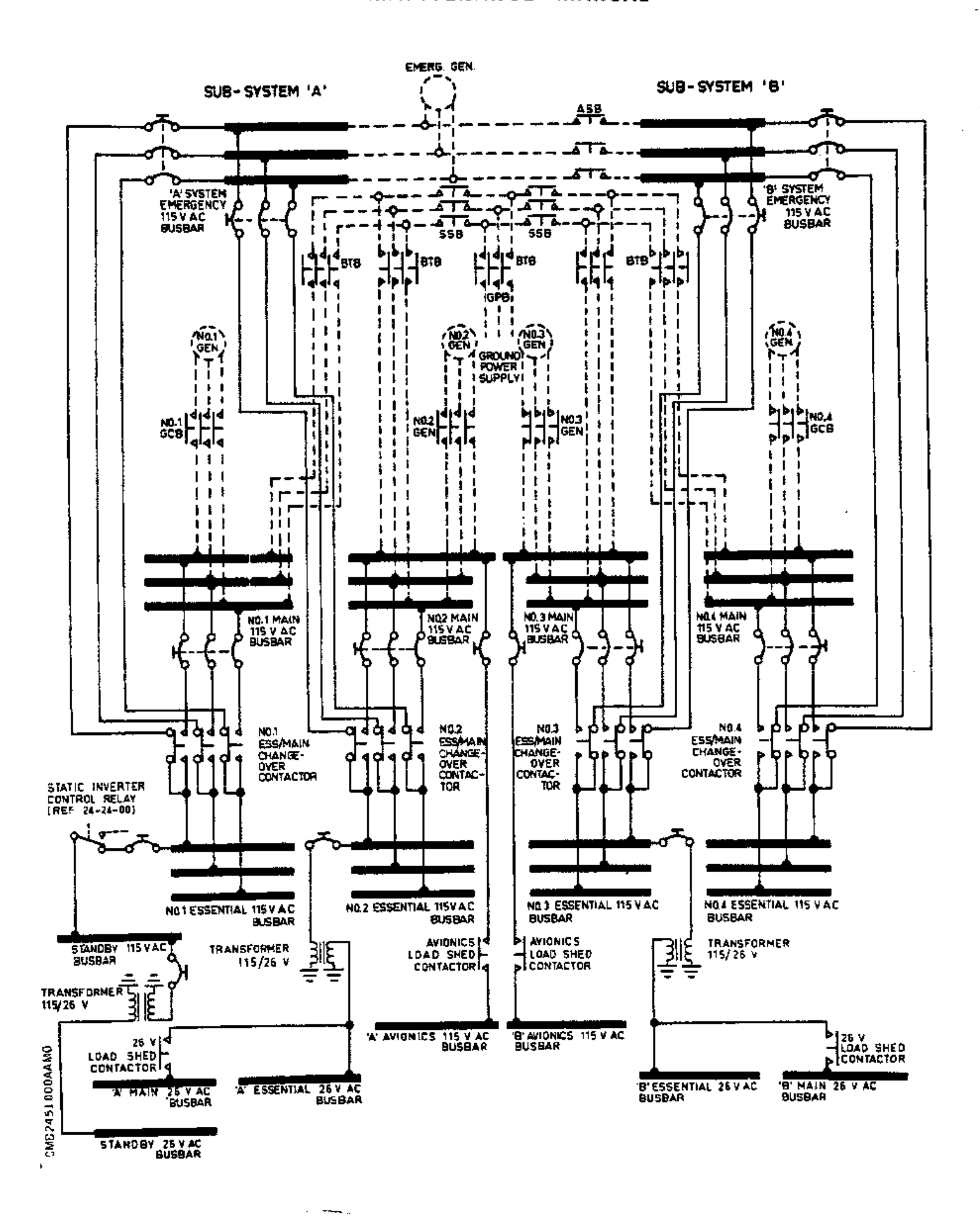
Control of the system is mainly automatic and normally all four generators operate in parallel, but manual control of the GCBs, BTBs, and SSBs is provided to permit isolation of a power source or selection of single or parallel channel combinations as required (Ref. 24-21-00).

The four three-phase essential a.c. busbars are normally connected, one to each main a.c. busbar, by an associated essential/main change-over contactor. These contactors operate in an emergency generation control system so that in the event of loss of voltage on any main a.c. busbar, the affected essential a.c. busbar is automatically connected to the output of an emergency generator (Ref. 24-22-00). Each change-over contactor is subject to control by an associated NORM-EMERG switch so that, if necessary, change-over of the essential a.c. busbar as above can be effected manually, irrespective of busbar voltage.

In each distribution channel, a magnetic indicator indicates interconnection or disconnection of the main and essential a.c. busbars and a warning caption is associated with each busbar to indicate significant loss of busbar voltage. Undervoltage warning and the automatic switching of essential a.c. loads to the emergency generator supply is effected by a.c. undervolt units, coupled one to the main and one to the essential busbar. Undervoltage signals operating the warning caption lights are also fed to the master warning system (Ref. 33-15-00).

Four three-phase engine relight a.c. busbars are normally

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AC Distribution - Simplified Schematic
Figure 001

connected, one to each main a.c. busbar, by an associated engine relight change-over contactor. In the event of loss of supply to any main a.c. busbar, the affected relight busbar can be connected to the emergency generator supply by operation of a manual selector switch on the engine starting panel.

Nos.2 and 3 a.c. power distribution channels provide power for single-phase 115 V a.c. 'A' and 'B' avionics busbars and single-phase 26 V a.c. 'A' and 'B' main and 'A' and 'B' essential busbars. Both 'A' and 'B' avionics busbars and 'A' and 'B' main 26 V a.c. busbars are shed automatically under certain conditions of power supply failure.

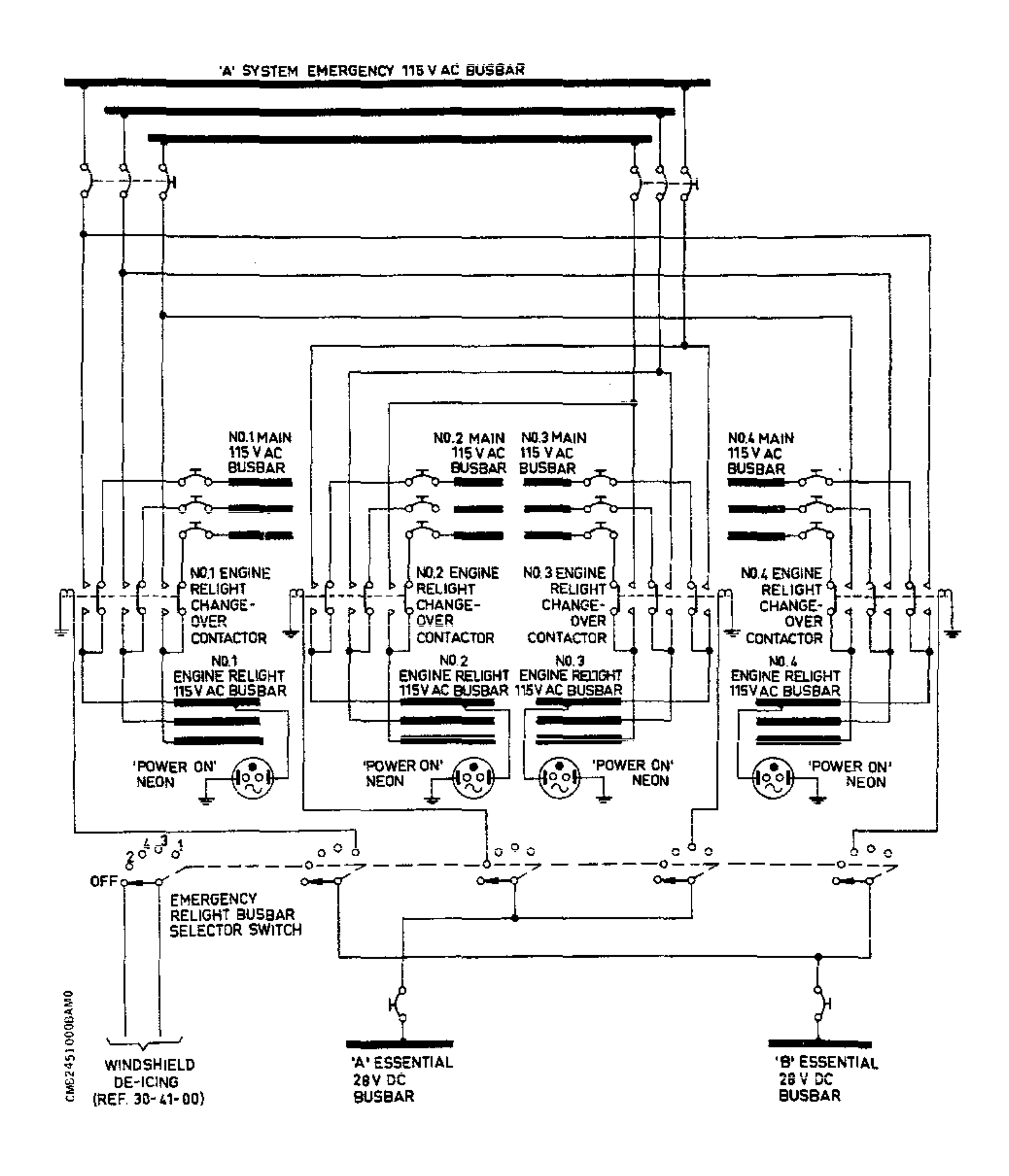
No.1 essential busbar supplies the normal power, and a static inverter the standby power, for a standby single-phase 115 V a.c. busbar and an associated standby single-phase 26 V a.c. busbar. These busbars supply certain essential instruments and are part of a standby a.c. generation system associated with ram air turbine operation (Ref. 24-24-00).

For aircraft ground servicing the main a.c. busbars can be connected to an external power supply through a ground supply plug and a ground power breaker (GPB) (Ref. 24-41-00). Protection circuits prevent the paralleling of main generators and ground power so that, when ground power is connected, the GPB is automatically tripped whenever an aircraft generator is brought into operation (Ref. 24-21-00 and 24-41-00). A further contactor connects the external supply to selected ground services only through a separate ground service distribution system (Ref. 24-41-00).

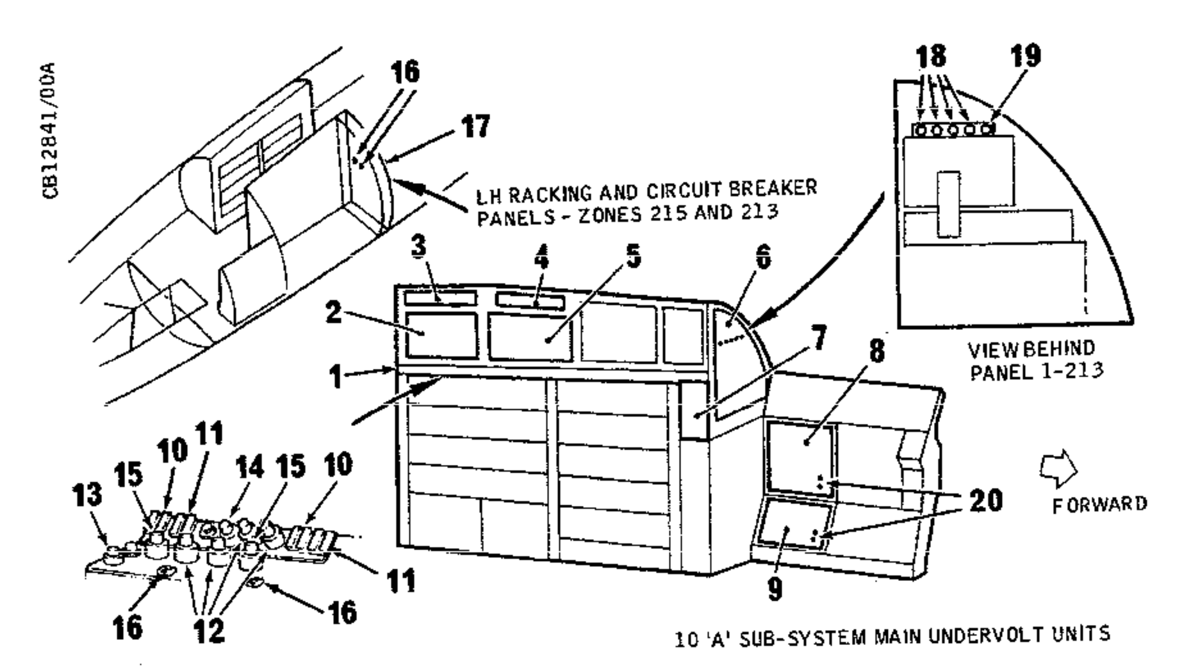
The a.c. distribution circuit breaker panels are located in the flight compartment, and the controls, indicators and caption lights are mounted on panels at the third crew member's station. Change-over contactors, load shed relays, undervolt units, transformers and 'power on' warning neon indicators are housed in the flight compartment left-hand and right-hand racking.

2. Main 200/115 V Three-phase 400 Hz Distribution
(Ref. Fig. 001, 003 and 004)

The output from each generation channel is distributed through terminal blocks in the flight compartment left-hand and right-hand racking, i.e., on shelf 12-215 (sub-system 'A') and shelf 12-216 (sub-system 'B') and thence to the main a.c. busbar distribution circuit breakers on panels 22-215 and 14-215 (No.1 main a.c. busbar), 21-215 and 13-215 (No.2 main a.c. busbar), 21-216 and 13-216 (No.3



Engine Relight Busbar Supply and
Change-over Control - Simplified Schematic
Figure 002



1 FLIGHT COMPARTMENT LEFT-HAND RACKING, SHELF 12-215

2 BUSBARS: NO.2 MAIN AC, 'A' AVIONICS 115VAC AND 'A' MAIN 26VAC (DISTRIBUTION PANEL 13-215)

3 NO.2 MAIN AC BUSBAR (DISTRIBUTION PANEL 21-215)

4 NO.1 MAIN AC BUSBAR (DISTRIBUTION PANEL 22-215)

5 NO.1 MAIN AC BUSBAR (DISTRIBUTION PANEL 14-215)

6 ENGINE RELIGHT BUSBARS (DISTRIBUTION PANEL 1-213)

7 'A' AND 'B' SUB-SYSTEM EMERGENCY 115VAC BUSBAR (DISTRIBUTION PANEL 23-215)

8 BUSBARS NO.1 AND 2 ESSENTIAL AC, 'A' ESSENTIAL 26VAC, STANDBY 115VAC AND STANDBY 26VAC, ALSO 26V1800 H_z (REF.27-15-00) DISTRIBUTION PANEL 2-213

9 BUSBARS: NOS.3 AND 4 ESSENTIAL AC AND 'B' ESSENTIAL 26VAC (DISTRIBUTION PANEL 4-213)

10 'A' SUB-SYSTEM MAIN UNDERVOLT UNITS

11 'A' SUB-SYSTEM ESSENTIAL UNDERVOLT UNITS

12 ENGINE RELIGHT CHANGE-OVER CONTACTORS

13 'A' SUB-SYSTEM 26V LOAD SHED CONTACTOR

14 'A' SUB-SYSTEM AVIONICS LOAD SHED CONTACTOR

15 'A' SUB-SYSTEM ESSENTIAL/MAIN CHANGE-OVER CONTACTORS

16 'A' SUB-SYSTEM 'POWER ON' NEON INDICATORS (NOS.1 AND 2 MAIN AC BUSBARS)

17 EQUIPMENT PANEL 24-215

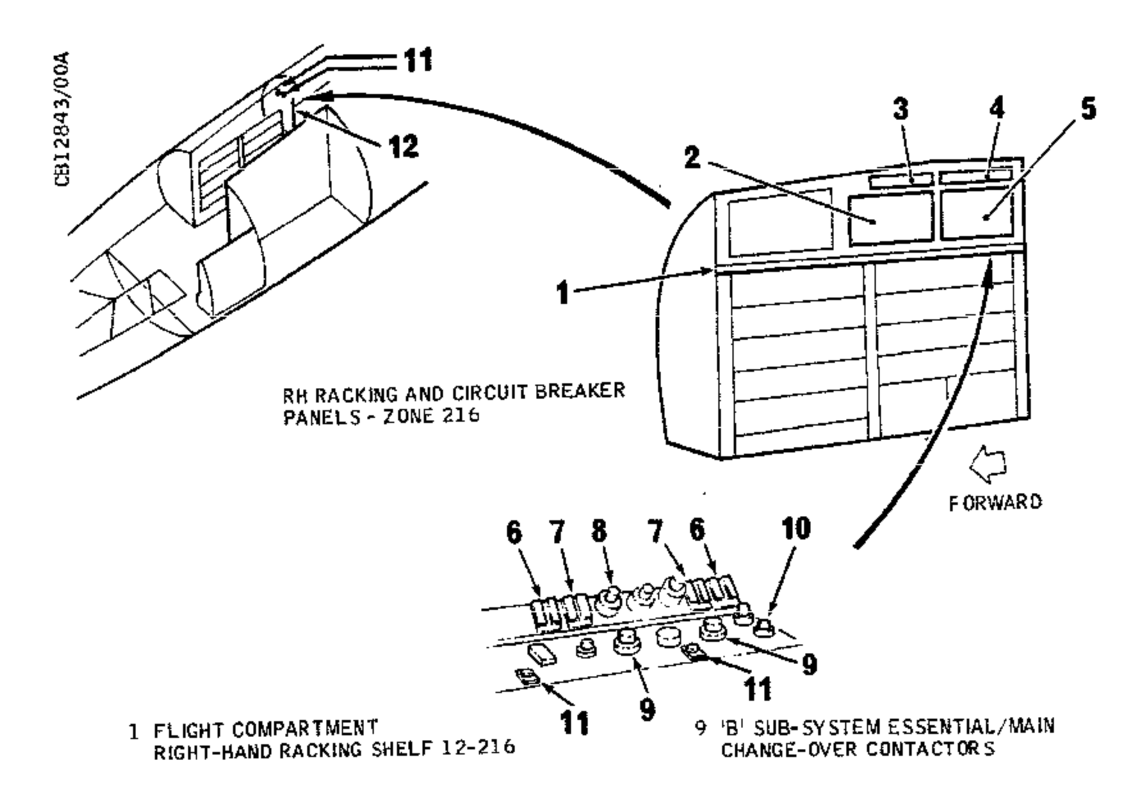
18 'POWER ON' NEON INDICATORS (NOS.1, 2, 3 AND 4 ENGINE RELIGHT BUSBARS)

19 'POWER ON' NEON INDICATOR ('A' SUB-SYSTEM EMERGENCY AC BUSBAR)

20 'POWER ON' NEON INDICATORS ON INNER FACE OF CIRCUIT BREAKER PANELS (NOS.1,2,3 AND 4 ESSENTIAL AC BUSBARS)

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- AC Distribution - Equipment Location -
Zones 215 and 213
Figure 003



1 FLIGHT COMPARTMENT
RIGHT-HAND RACKING SHELF 12-216

2 NO.4 MAIN AC BUSBAR
(DISTRIBUTION PANEL 14-216)

3 NO.4 MAIN AC BUSBAR
(DISTRIBUTION PANEL 22-216)

4 NO.3 MAIN AC BUSBAR
(DISTRIBUTION PANEL 21-216)

5 BUSBARS: NO.3 MAIN AC, 'B' AVIONICS
115VAC AND 'B' MAIN 26VAC
(DISTRIBUTION PANEL 13-316)

6 'B' SUB-SYSTEM MAIN UNDERVOLT UNITS

7 'B' SUB-SYSTEM ESSENTIAL UNDERVOLT UNITS

8 'B' SUB-SYSTEM 26V LOAD SHED CONTACTOR

9 'B' SUB-SYSTEM ESSENTIAL/MAIN
CHANGE-OVER CONTACTORS

10 'B' SUB-SYSTEM AVIONICS LOAD
SHED CONTACTOR

11 'B' SUB SYSTEM 'POWER ON' NEON
INDICATORS (NOS.3 AND 4 MAIN
AC BUSBARS)

12 EQUIPMENT PANEL 24-216

CMB2451000DAM0

- AC Distribution - Equipment Location -
Zone 216
Figure 004

main a.c. busbar) and 22-216 and 14-216 (No.4 main a.c. busbar). 'Power on' neon indicators are connected, one to phase A and one to phase C of each main a.c. busbar, to indicate to servicing personnel that the 200/115 V circuits are 'live'.

A three-phase main a.c. undervolt unit is connected to each main a.c. busbar to detect loss of voltage and provide an undervolt warning signal by illumination of a correspondingly numbered AC MAIN BUS caption. Each main a.c. undervolt unit also provides automatic switching control of the associated essential/main change-over contactor.

3. Essential 200/115 V Three-phase 400 Hz Distribution (Ref. Fig.001 and 003)

The essential a.c. busbars comprise cable links and terminal blocks mounted on panel 7-213. The associated distribution circuit breakers are mounted on panel 2-213 (Nos.1 and 2 essential a.c. busbars) and on panel 4-213 (Nos.3 and 4 essential a.c. busbars). A 'power on' neon indicator is connected to each essential a.c. busbar to indicate to servicing personnel that the 200/115 V circuits are 'live'.

Nos.1, 2, 3 and 4 essential a.c. busbars are normally connected, each to the correspondingly numbered main a.c. busbar, by closure of the essential/main change-over contactor. Each change-over contactor is controlled by the correspondingly numbered main a.c. undervolt unit sensing from the respective main a.c. busbar, and the correspondingly numbered NORM/EMERG switch.

When a change-over contactor is in the open condition, the associated a.c. essential busbar is isolated from the correspondingly numbered main a.c. busbar and is connected to the associated ('A' system or 'B' system) emergency busbar supply.

Each essential/main change-over contactor controls a two-position magnetic indicator to denote that the associated essential a.c. busbar is connected to or isolated from the main a.c. busbar supplies.

In addition a three-phase a.c. undervolt unit is connected to each essential a.c. busbar to detect a loss of essential a.c. busbar supplies and provide an undervolt warning signal by illumination of a correspondingly numbered AC ESS BUS caption.

Essential/main change-over contactors associated with 'A' sub-system are housed in the flight compartment left-hand

racking on shelf 12-215, while those associated with 'B' sub-system are in the right-hand racking on shelf 12-216.

4. Three-phase AC Undervolt Units
(Ref. Fig. 003, 004 and 006)

The undervolt units associated with 'A' sub-system are mounted in the flight compartment left-hand racking on shelf 12-215, and those associated with 'B' sub-system in the right-hand racking on shelf 12-216.

The four main and four essential a.c. undervolt units are identical, each comprising a voltage sensing circuit and associated relay with two sets of change-over contacts.

Each a.c. undervolt unit senses the voltage of the associated a.c. busbar to detect an undervoltage condition and provides internal switching to control external circuits. The relay is energized when the busbar voltage rises above a pre-determined level and de-energized if the voltage falls below this level.

5. Emergency 200/115 V Three-phase 400 Hz Distribution
(Ref. Fig.001 and 003)

The emergency a.c. busbars comprise cable links and terminal blocks mounted on shelf 12-215. The associated distribution circuit breakers are mounted on panel 23-215.

Two outputs are available from the emergency generation system (Ref. 24-22-00). One is applied direct to 'A' system emergency 200/115 V a.c. busbar, and the other to 'B' system emergency a.c. busbar through an auto-shed breaker (ASB) which is automatically de-energized to shed 'B' system emergency busbar loads for certain engine failure conditions (Ref. 24-22-00).

A 'power on' neon indicator is connected to the 'A' system emergency busbar to indicate to servicing personnel that the 200/115 V circuits are 'live'.

6. Engine Relight 200/115 V Three-phase Distribution
(Ref. Fig.002 and 003)

The engine relight busbars comprise cable links and terminal blocks mounted on shelf 12-215 and include connections to the distribution circuit breakers on panel 1-213.

Nos.1, 2, 3 and 4 relight busbars are normally connected, each to the similarly numbered main a.c. busbar, through an engine relight change-over contactor. Each relight change-

over contactor is controlled by the operation of an emergency relight busbar selector switch interposed in the control circuitry to provide a manual change-over facility. In the event of failure of a main a.c. busbar supply the affected engine relight busbar can be disconnected from the associated main a.c. busbar and reconnected to 'A' system emergency busbar supply by selective switching of the emergency relight busbar selector switch. The emergency relight busbar selector switch provides additional control so that selection of any one of the four emergency busbar supply positions effects the simultaneous shedding of certain windshield de-icing loads (Ref. 30-41-00).

A 'power on' neon indicator is connected to each engine relight busbar to indicate to servicing personnel that the 200/115 V circuits are 'live'.

7. Avionics Load Shed 115 V Single-phase Distribution (Ref. Fig. 001, 003 and 004)

A single-phase output from phase 'A' of Nos.2 and 3 main 115 V a.c. busbars is fed through load shed contactors on shelf 12-215 and shelf 12-216, respectively, to the avionics distribution circuit breakers on panels 13-215 ('A' avionics 115 V a.c. busbar) and 13-216 ('B' avionics 115 V a.c. busbar).

Each load shed contactor is controlled by the associated main a.c. undervolt unit and interposed NORM/EMERG switch so that the avionics loads are automatically shed if main a.c. busbar undervoltage occurs, or by manual operation of the NORM/EMERG switch.

8. 26 V Single-phase 400 Hz Distribution (Ref. Fig. 001, 003 and 004)

26 V 400 Hz single-phase a.c. is supplied by two 115/26 V single-phase transformers (Ref. 24-23-00). The input to one transformer is taken from No.2 essential 115 V a.c. busbar, and the input to the other from No.3 essential 115 V a.c. busbar. The transformer outputs are connected direct to the essential 26 V a.c. distribution busbars and circuit breaker panels 2-213 (sub-system 'A') and 4-213 (sub-system 'B'), and through 26 V load shed contactors on shelf 12-215 and shelf 12-216 to the main 26 V a.c. distribution busbars and circuit breaker panels 13-215 and 13-216 ('A' and 'B' sub-system respectively).

Each load shed contactor is controlled by the associated main a.c. undervolt unit and interposed NORM/EMERG switch so that the respective main 26 V a.c. load is shed if

main a.c. busbar undervoltage occurs, or by manual operation of the NORM/EMERG switch.

9. Standby 115 V and 26 V Single-phase Distribution
(Ref. Fig.001 and 003)

The standby 115 V busbar and the standby 26 V busbar comprise cable links and distribution circuit breakers on panel 2-213, power for the latter busbar being taken from the former busbar through a 115/26 V single-phase transformer (Ref. 24-24-00).

The standby 115 V a.c. busbar (and hence the standby 26 V a.c. busbar) is normally supplied with power from No.1 essential a.c. busbar. A static inverter control relay interposed in the supply circuit changes over the standby 115 V busbar (and hence the standby 26 V a.c. busbar) to power supplies provided by a static inverter when the ram air turbine is selected for operation (Ref. 24-24-00).

10. 26 V 1,800 Hz Single-phase AC Distribution

Supplies of 26 V 1,800 Hz single-phase a.c. are provided specifically for flight controls from two busbars on panel 2-213. The generation of these supplies is described in 27-15-00.

11. Instrument Ground Disconnect (IGD) Busbars

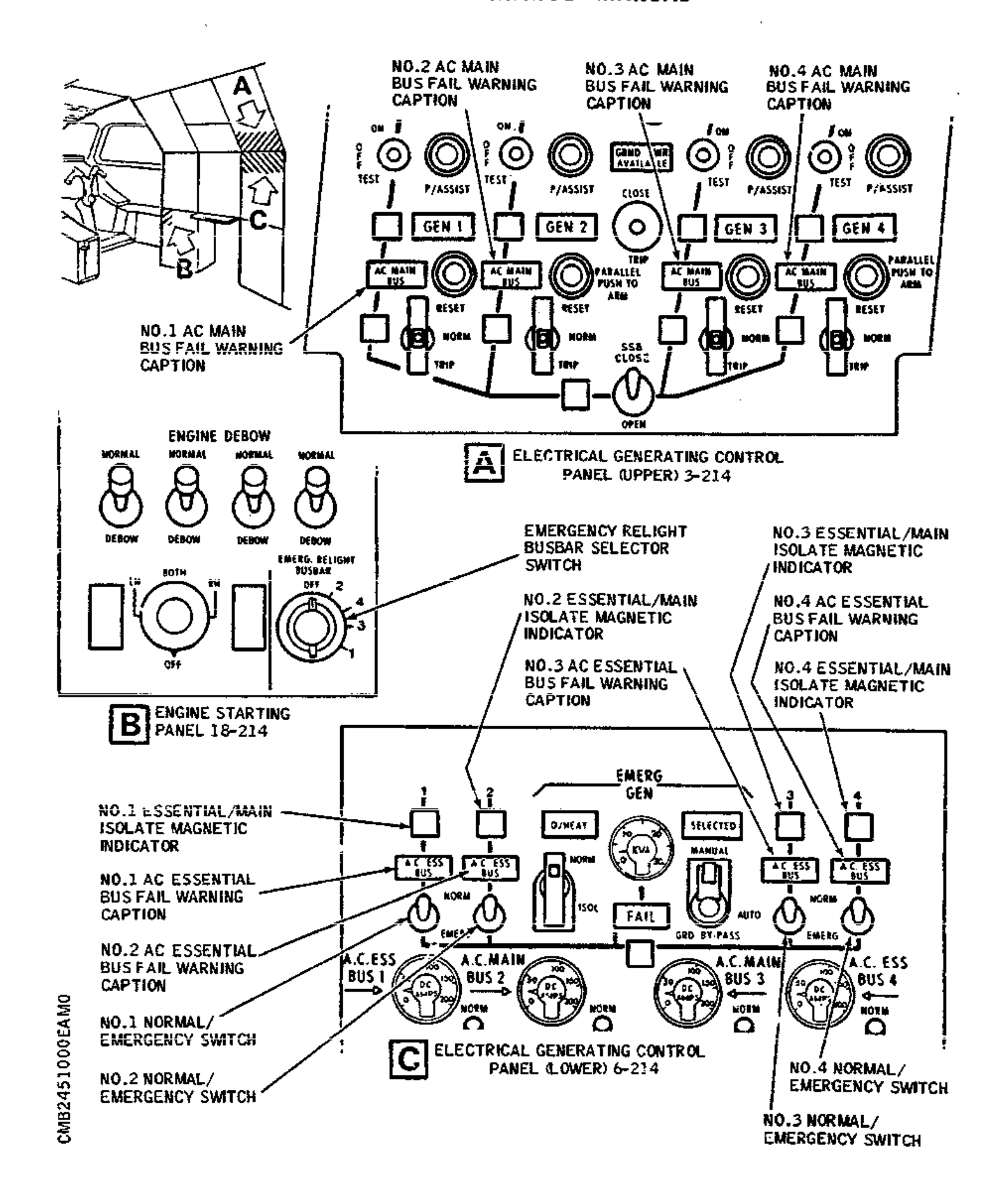
There are ten instrument ground disconnect (IGD) busbars, each of which supplies a particular group of services. The supply to each IGD busbar is controlled by an associated one of ten master isolation circuit breakers which must be tripped while the aircraft is on the ground subject to individual test requirements. This disconnect facility is provided to avoid the unnecessary running of equipment and/or overheating of certain groups of instruments/ equipment if the cooling air supply is absent or inadequate.

The identification of each master isolation circuit breaker and the services (system circuit breakers) supplied by the associated IDG busbar are given in 24-41-00 under the heading 'Isolation of Certain Instruments/Equipment'.

12. Operation

A. Control and Indication (Ref. Fig. 003, 004 and 005)
(Ref. Fig. 006)

The AC MAIN BUS fail caption lights are mounted on the upper section of the electrical generating control



AC Distribution - Controls and Indicators
Figure 005

panel (panel 3-214), with the essential/main isolate magnetic indicators, the AC ESS BUS fail caption lights and the NORM/EMERG control switches on the lower section of the panel (panel 6-214).

The controls and indicators are numbered and positioned with respect to interconnecting lines engraved on the panel to form an operational diagram of the distribution system relative to the power supplies. The magnetic indicators show 'in-line' or 'cross-line' in relation to the interconnecting lines to denote the 'closed' or 'open' position of the associated essential/main change-over contactors and thus depict connection or disconnection between correspondingly numbered main and essential a.c. busbars.

The 'power on' neon indicators are located in appropriate positions in the flight compartment left-hand and right-hand racking to indicate to servicing personnel that the 200/115 V circuits are 'live'. They are related and located as follows.

(1) The four 'power on' neon indicators connected to phase A of Nos.1, 2, 3 and 4 main a.c. busbars respectively are located, Nos.1 and 2 on shelf 12-215 and Nos.3 and 4 on shelf 12-216.

(2) The four 'power on' neon indicators connected to phase C of Nos.1, 2, 3 and 4 main a.c. busbars respectively are located, Nos.1 and 2 together on equipment panel 24-215 and Nos.3 and 4 together on equipment panel 24-216.

(3) The four 'power on' neon indicators connected to Nos.1, 2, 3 and 4 essential a.c. busbars respectively are mounted, Nos.1 and 2 on the inner face of the circuit breaker panel 2-213 and Nos.3 and 4 on the inner face of circuit breaker panel 4-213.

(4) The 'power on' neon indicator connected to the 'A' emergency a.c. busbar and the four 'power on' neon indicators connected to Nos.1, 2, 3 and 4 engine relight busbars respectively are grouped at the forward end of shelf 12-215 (behind circuit breaker panel 1-213).

The NORM/EMERG switch for each distribution channel is located below the corresponding channel AC ESS BUS fail caption light. The switches have NORM and EMERG positions which are effective as follows:

(1) NORM: The automatic control circuit of the associated essential/main change-over contactor is connected so that when the voltage of the corresponding a.c. main busbar falls below a predetermined level -

(a) the associated a.c. essential busbar is disconnected from the main a.c. busbar and reconnected to the respective 'A' system or 'B' system emergency a.c. supply busbar, and

(b) the automatic control circuit of the emergency generator is armed to bring that generator into operation (Ref. 24-22-00).

(2) EMERG: The automatic control circuit of the associated essential/main change-over contactor is interrupted to give the same effect as that indicated in (a) and (b) above.

The appropriate AC MAIN BUS caption is illuminated if the voltage of the corresponding a.c. main busbar falls below the predetermined level. The warning signal that effects illumination of the AC MAIN BUS caption is also applied to the master warning system (Ref. 33-15-00).

The appropriate AC ESS BUS caption is illuminated if the voltage of the corresponding a.c. essential busbar falls below the predetermined level. The warning signal that effects illumination of the AC ESS BUS caption is also applied to the master warning system (Ref. 33-15-00).

The AC MAIN BUS and the AC ESS BUS caption lights incorporate a press-to-test facility. The filaments in these caption lights can be tested also by the flight compartment lights test and dimming facility (Ref. 33-14-00).

The EMERG RELIGHT BUSBAR selector switch is mounted on the engine starting panel (panel 18-214). This is a rotary selector switch providing OFF, 2, 4, 3 and 1 positions in clockwise sequence which are effective as follows:

(1) OFF: each relight busbar is connected to the similarly numbered main a.c. busbar.

(2) Positions 2, 4, 3, 1: at each position the selected engine relight busbar is connected to

the 'A' system emergency busbar.

B. Functional Description (Ref. Fig. 001, 002 and 006)

Under normal operating conditions, the NORM/EMERG switches are set at NORM and the EMERG RELIGHT BUSBAR selector switch at OFF. With normal operation of the main a.c. generation system (Ref. 24-21-00) all four BTBs and the two SSBs are closed and the outputs of the four main generators are therefore applied in parallel to the four main a.c. busbars.

At each main a.c. busbar the associated main undervolt unit senses the voltage of the 200/115 V three-phase 400 Hz line-to-neutral busbar supply and energizes the internal relay when the voltage rises to 100 V, approximately. In consequence, the essential/main change-over contactor and the associated avionics and 26 V load shed contactors are energized and so each main a.c. busbar is connected to the similarly numbered essential a.c. busbar with an in-line indication on the appropriate magnetic indicator. 200/115 V a.c. power supplies are thus available at the four main a.c. busbars, the four essential a.c. busbars and the 'A' and 'B' avionics busbars. Each main a.c. undervolt unit also completes an earth return in the control circuit of the d.c. distribution system (Ref. 24-52-00).

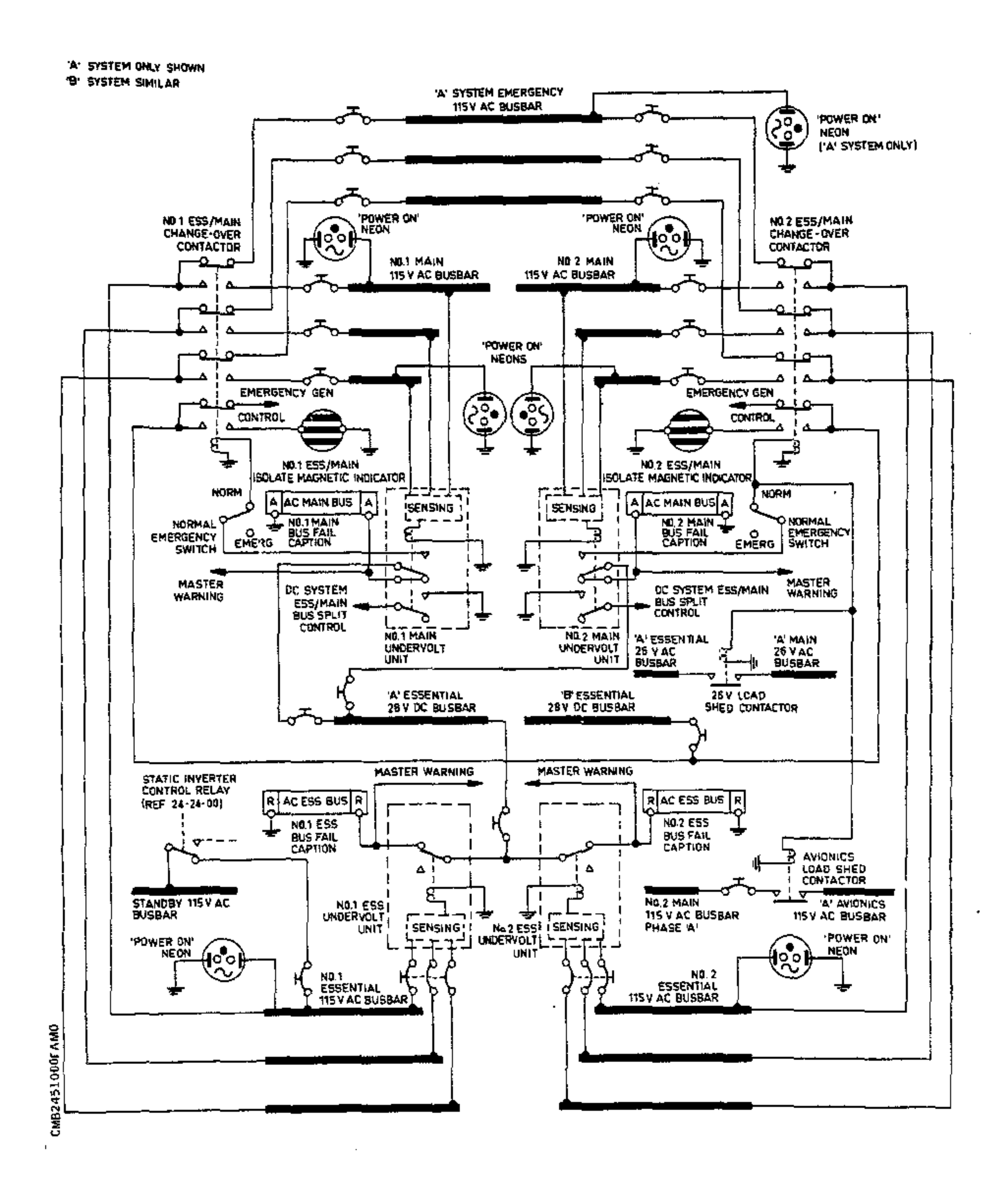
Since the two 115/26 V a.c. transformers are energized by essential a.c. supplies (Ref. 24-23-00), power supplies are also available at the 'A' and 'B' essential 26 V a.c. busbars and, through the energized load shed contactors, at the 'A' and 'B' main 26 V a.c. busbars.

With the static inverter control relay de-energized, a single-phase output from No.1 essential a.c. busbar supplies the standby 115 V a.c. busbar and, through the associated 115/26 V a.c. transformer, the standby 26 V a.c. busbar (Ref. 24-24-00).

In addition, with the EMERG RELIGHT BUSBAR selector switch at OFF the four engine relight busbars are energized by the four main a.c. busbars.

Setting any one NORM/EMERG control switch to EMERG de-energizes the associated essential/main change-over contactor, and hence the associated essential a.c. busbar is disconnected from the respective main busbar and reconnected to the related ('A' system or 'B'

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- AC Distribution - Control and Indication -
Simplified Schematic
Figure 006

system) emergency supply busbar.

The operation of the essential/main change-over contactor also -

(1) makes a preparatory connection in the automatic control circuit of the emergency generator to initiate automatic operation (Ref. 24-22-00), and

(2) de-energizes the associated magnetic indicator to show 'cross-line'.

If Nos.2 or 3 essential/main change-over contactors are de-energized the associated 'A' or 'B' sub-system load shed contactors are de-energized simultaneously to shed the loads on the avionics 115 V a.c. busbar and the main 26 V a.c. busbar. This simultaneous load shedding ensures that power supplies from the associated avionics 115 V a.c. busbar and the associated main 26 V a.c. busbar are both removed from a using system when automatic or manual switching to the emergency power supply busbars is effected.

If a power malfunction is sensed at a main a.c. busbar the relay in the associated main a.c. undervolt unit is tripped if the busbar voltage falls to 100 V, approximately, for longer than 200 to 250 ms. In consequence -

(1) the appropriate essential/main change-over contactor is de-energized in the same manner and with the same results as with the NORM/EMERG switch set to EMERG,

(2) the correspondingly numbered AC MAIN BUS caption is illuminated and the activating warning signal applied to the master warning system (Ref. 33-15-00), and

(3) an earth return circuit is interrupted in the d.c. distribution system (Ref. 24-52-00).

Since the main and essential a.c. undervolt units are identical, a fall in essential busbar voltage similar to that described for a main busbar trips the relay in the associated a.c. essential undervolt unit. In consequence, the correspondingly numbered AC ESS BUS caption is illuminated and the activating warning signal is applied to the master warning system (Ref. 33-15-00).

As previously stated, automatic or manual switching of the 'A' sub-system essential/main change-over contactors connects 'A' sub-system essential a.c. busbars to 'A' system emergency busbar supply, while automatic or manual switching of 'B' sub-system change-over contactors connects the 'B' sub-system essential a.c. busbars to the 'B' system emergency busbar supply. However, for certain engine failure conditions 'B' system emergency busbar loads are shed (Ref. 24-22-00).

In the event of a failure of a main a.c. busbar, setting the EMERG RELIGHT BUSBAR selector switch to the required number -

(1) energizes the correspondingly numbered engine relight change-over contactor which disconnects the associated relight busbar from the respective main a.c. busbar and reconnects it to 'A' system emergency supply busbar, and

(2) effects the shedding of certain windshield de-icing loads by interruption of an associated control circuit (Ref. 30-41-00).

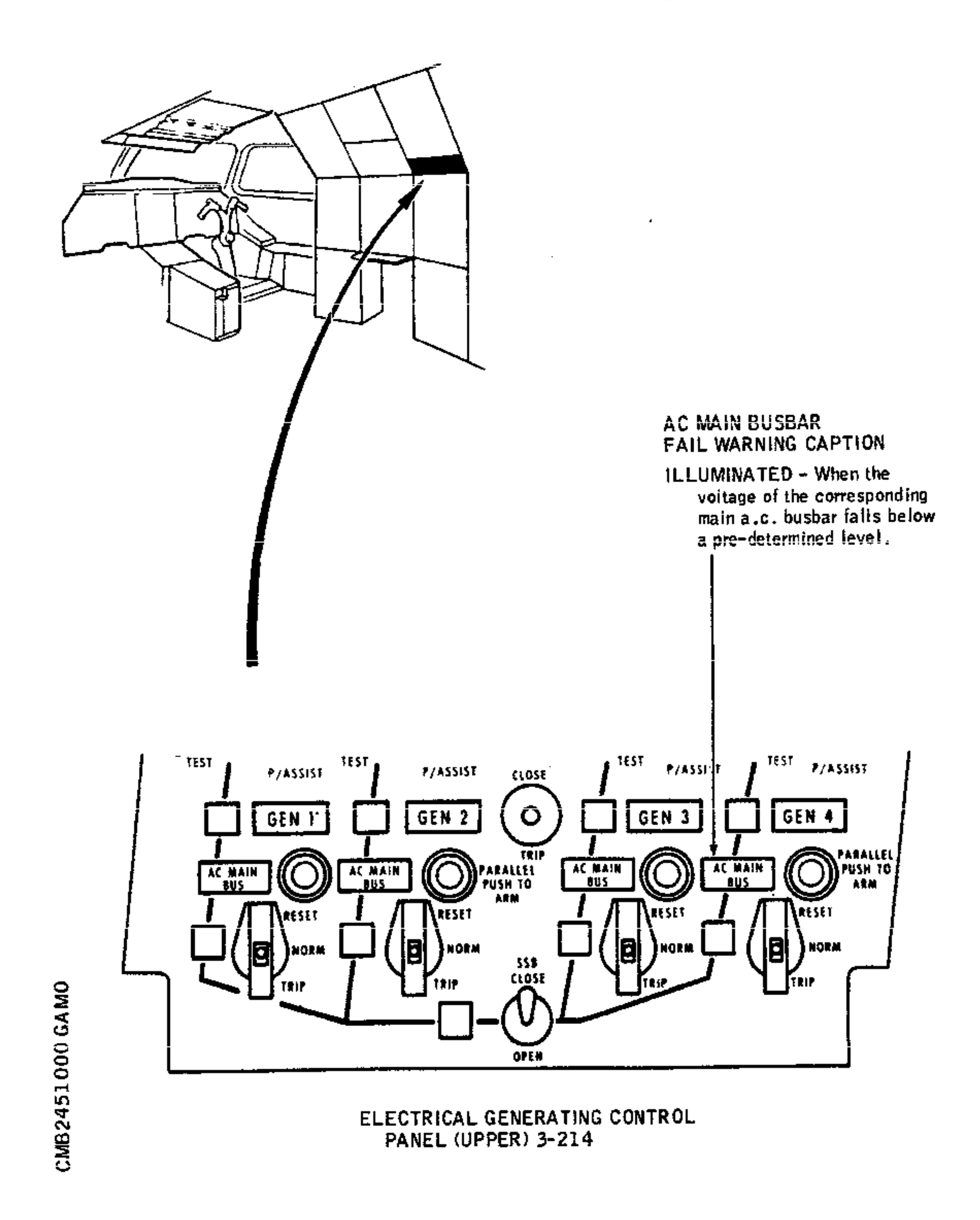
If the ram air turbine is selected, the static inverter control relay is simultaneously energized and switches power supply connections so that the standby 115 V a.c. supply busbar is disconnected from No.1 essential busbar and the static inverter instead supplies the standby 115 V a.c. supply busbar and, through the associated 115/26 V a.c. transformer, the standby 26 V a.c. busbar (Ref. 24-24-00).

13. System Management (Ref. Fig. 007)

**ON A/C 001-005,
(Ref. Fig. 008)

The main a.c. distribution system distributes a.c. power from the a.c. main generators (Nos.1, 2, 3 and 4), the emergency generator or the external power source to the user systems. In normal operation, the system functions automatically with the main a.c. busbars paralleled by the bus-tie breakers and split system breakers (Ref. 24-21-00).

Automatic controls cause loads to be transferred/shed if certain power sources fail. Manual control is also available to effect disconnection/interconnection of busbars if required.



AC Distribution - System Management (1)
Figure 007

CBI2958/00B

ENGINE STARTING PANEL 18-214

RELIGHT BUSBAR SELECTOR SWITCH

OFF - each relight busbar connected to the correspondingly numbered main a.c. busbar.

2, 4, 3, 1 - at each position, the selected engine relight busbar is connected to the 'A' emergency busbar.

ESSENTIAL/MAIN ISOLATE M.I.

IN-LINE - essential a.c. busbar supplied from the correspondingly numbered main a.c. busbar.

CROSS-LINE - essential a.c. busbar not supplied from its associated main busbar.

AC ESSENTIAL BUSBAR FAIL WARNING CAPTION

ILLUMINATED - when the voltage of the corresponding essential busbar falls below a predetermined level.

ELECTRICAL GENERATING CONTROL PANEL (LOWER) 6-214

NORMAL/EMERGENCY CONTROL SWITCH

NORM - essential a.c. busbar supplied from correspondingly-numbered main a.c. busbar.

EMERG - set to initiate run-up of emergency generator and change over the essential a.c. busbar to the associated 'A' or 'B' emergency a.c. busbar and hence to the output of the emergency generator.

NOTE: Run-up of the emergency generator by operation of a NORMAL/EMERGENCY switch to EMERG is normally inhibited while the aircraft is on the ground unless

(a) the emergency a.c. generation system is set for 'ground by-pass' operation and the green hydraulic system is pressurized, or

(b) After SB24-023, No.1 and/or No.2 engine(s) is/are running (Ref. 24-22-00).

AUTO-SHED BREAKER M.I.

IN-LINE - ASB closed; all essential a.c. busbars can be supplied from emergency generator.

CROSS-LINE - ASB open 'B' emergency busbar isolated. Emergency generator supply limited to 'A' sub-system (Nos.1 and 2) essential a.c. busbars only. ASB will open when both Nos.1 and 2 engine speeds fall below 58 per cent N2.

CMB 24 51 00 0 HAMO

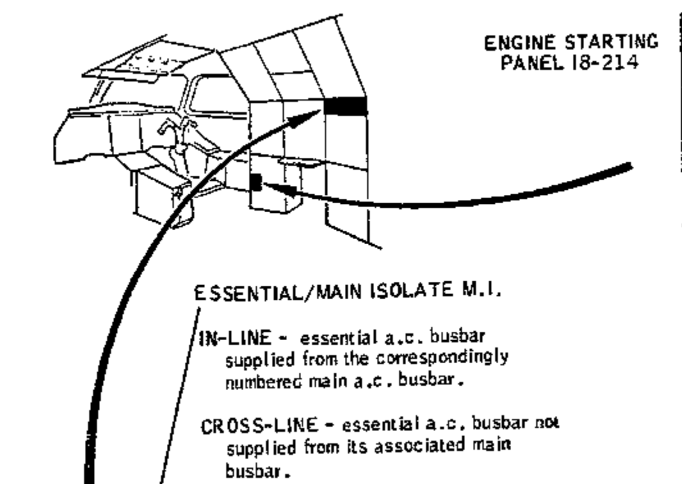
AC Distribution - System Management (2)
Figure 008

R **ON A/C 006-007,
(Ref. Fig. 009)

The main a.c. distribution system distributes a.c. power from the a.c. main generators (Nos.1, 2, 3 and 4), the emergency generator or the external power source to the user systems. In normal operation, the system functions automatically with the main a.c. busbars paralleled by the bus-tie breakers and split system breakers (Ref. 24-21-00).

Automatic controls cause loads to be transferred/shed if certain power sources fail. Manual control is also available to effect disconnection/interconnection of busbars if required.

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ENGINE STARTING PANEL 18-214

RELIGHT BUSBAR SELECTOR SWITCH

OFF - each relight busbar connected to the correspondingly numbered main a.c. busbar.

2, 4, 3, 1 - at each position, the selected engine relight busbar is connected to the 'A' emergency busbar.

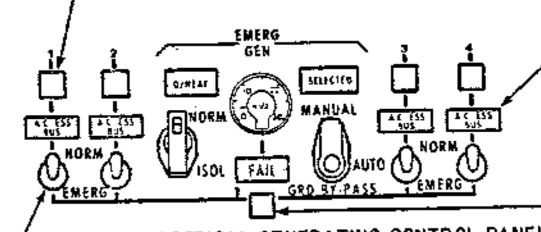
ESSENTIAL/MAIN ISOLATE M.I.

IN-LINE - essential a.c. busbar supplied from the correspondingly numbered main a.c. busbar.

CROSS-LINE - essential a.c. busbar not supplied from its associated main busbar.

AC ESSENTIAL BUSBAR FAIL WARNING CAPTION

ILLUMINATED - when the voltage of the corresponding essential busbar falls below a predetermined level.



ELECTRICAL GENERATING CONTROL PANEL (LOWER) 6-214

NORMAL/EMERGENCY CONTROL SWITCH

NORM - essential a.c. busbar supplied from correspondingly-numbered main a.c. busbar.

EMERG - set to initiate run-up of emergency generator and change over the essential a.c. busbar to the associated 'A' or 'B' emergency a.c. busbar and hence to the output of the emergency generator.

NOTE: Run-up of the emergency generator by operation of a NORMAL/EMERGENCY switch to EMERG is normally inhibited while the aircraft is on the ground unless

(a) No.1 and/or No.2 engine(s) is/are running,
or
(b) the emergency a.c. generation system is set for 'ground by-pass' operation and the green hydraulic system is pressurized (Ref. 24-22-00).

AUTO-SHED BREAKER M.I.

IN-LINE - ASB closed; all essential a.c. busbars can be supplied from emergency generator.

CROSS-LINE - ASB open 'B' emergency busbar isolated. Emergency generator supply limited to 'A' sub-system (Nos.1 and 2) essential a.c. busbars only. ASB will open when both Nos.1 and 2 engine speeds fall below 58 per cent N2.

CMB 24 51 00 0 HANO

AC Distribution - System Management (2)
Figure 009

AC UNDERVOLT UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

Eight a.c. undervolt units are mounted in the flight compartment racking: Nos.1 and 2 main and Nos.1 and 2 essential a.c. undervolt units on shelf 12-215, and Nos.3 and 4 main and Nos.3 and 4 essential a.c. undervolt units on shelf 12-216. Each undervolt unit is secured to a mounting panel on the shelf with bolts and washers. Electrical connections are made through two terminal blocks mounted on top of each undervolt unit cover.

The removal and installation procedures apply to any of the eight a.c. undervolt units.

2. AC Undervolt Unit

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN)	-
Torque spanner, 40 to 45 lbf in (0.452 to 0.509 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Trip the BAT A CONT circuit breaker 1P24 on panel 16-215, or the BAT B CONT circuit breaker 2P24 on panel 16-216, as applicable, and fit a safety clip.

(3) Open the appropriate circuit breaker panel to gain access to the undervolt unit on shelf 12-215, or shelf 12-216.

C. Remove

(1) Remove the undervolt unit terminal block covers and disconnect the electrical cables.

(2) Remove the bolts and washers securing the undervolt unit to the mounting panel and remove the unit.

(3) Refit the terminal block covers to the undervolt unit.

D. Install

(1) Comply with the electrical safety precautions.

(2) Place the undervolt unit on the mounting panel and secure it with the bolts and washers. Torque-tighten the bolts to between 40 and 45 lbf in (0.452 and 0.509 mdaN). Ensure that the unit is bonded in accordance with 20-27-11.

NOTE: In the following operation the toothed lock washer must be fitted immediately under the terminal screw head and followed by the plain washer.

(3) Connect the electrical cables to the undervolt unit, ensuring that the connections are made in accordance with the cable identification and the applicable wiring diagram. Torque-tighten the terminal screws to between 12 and 14 lbf in (0.137 and 0.160 mdaN).

(4) Fit the terminal block covers.

E. Conclusion

(1) Close and secure the circuit breaker panel.

(2) Remove the safety clips and reset the circuit breaker tripped in operation B.(2).

(3) Cancel the electrical safety precautions taken in operation B.(1).

(4) Carry out an Operational Test of the a.c. undervolt unit (Ref. Adjustment/Test).

AC UNDERVOLT UNIT - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

R The following Operational Test is primarily intended to
R check the a.c. undervolt unit after installation to
R confirm that it is operating correctly. Functional and System Tests are not considered necessary in this application.

The test procedures are arranged under separate sub-headings, namely, 2.B. Test Main AC Undervolt Unit, for a unit coupled to No.1, No.2, No.3 or No.4 main a.c. busbar, and 2.C. Test Essential AC Undervolt Unit, for a unit coupled to No.1, No.2, No.3 or No.4 essential a.c. busbar.

2. Operational Test

A. Prepare

R (1) Make available electrical ground power as detailed in 24-41-00.

R (2) Check that the AC MAIN BUS captions and the AC ESS BUS captions are extinguished, and the essential/main isolate magnetic indicators show in-line.

R (3) Check that the DC MAIN BUS caption is extinguished
R and both essential/main split magnetic indicators show in-line.

R (4) Set BATT A and BATT B control switches to "ON".

B. Test Main AC Undervolt Unit

(1) Isolate the appropriate main 115 V a.c. busbar by
R setting the associated bus-tie breaker (BTB) control switch, on panel 3-214, to "TRIP". Check that the AC MAIN BUS caption is illuminated and the essential/main isolate magnetic indicator changes from in-line to cross-line.

(2) Reset the BTB control switch to "NORM". Check that the associated AC MAIN BUS caption is extinguished and the magnetic indicator changes from cross-line to in-line.

R (3) With the BTB control switch used in operations

(1) and (2) set at NORM, set the other three BTB control switches to "TRIP" and check that the associated AC MAIN BUS captions are illuminated. Check that the DC MAIN BUS caption remains extinguished and both essential/main split magnetic indicators remain in-line.

(4) Set the BTB control switch remaining at NORM, to "TRIP", checking that both essential/main split magnetic indicators move with no delay from in-line to cross-line.

(5) Return all four BTB control switches to "NORM". Check that all four AC MAIN BUS captions are extinguished and both essential/main split magnetic indicators change from cross-line to in-line.

C. Test Essential AC Undervolt Unit

(1) Set the appropriate NORM/EMERG switch to "EMERG". Check that the associated AC ESS BUS caption is illuminated and the essential/main isolate magnetic indicator changes from in-line to cross-line.

(2) Reset the NORM/EMERG switch to "NORM". Check that the AC ESS BUS caption is extinguished and the magnetic indicator changes from cross-line to in-line.

D. Conclusion

(1) Set BATT A and BATT B control switches to "OFF".

(2) Switch off and disconnect electrical ground power as detailed in 24-41-00.

DC DISTRIBUTION - DESCRIPTION AND OPERATION

**ON A/C 007-007,

1. General (Ref. Fig. 001)

28 V d.c. power from the four transformer rectifier units (Nos.1, 2, 3 and 4 TRUs) of the d.c. generation system is distributed through two main and two essential 28 V d.c. busbars.

The d.c. distribution system is divided into two sub-systems to form sub-system 'A' and sub-system 'B', each sub-system containing a d.c. main and a d.c. essential busbar. The 28 V d.c. outputs from Nos.2 and 3 TRUs are fed direct to 'A' and 'B' sub-system main d.c. busbars respectively. Similar outputs from Nos.1 and 4 TRUs are fed to sub-system 'A' and 'B' essential d.c. busbars respectively through a reverse current breaker (RCB); each essential d.c. busbar can also be supplied from an associated battery (Ref. 24-31-00).

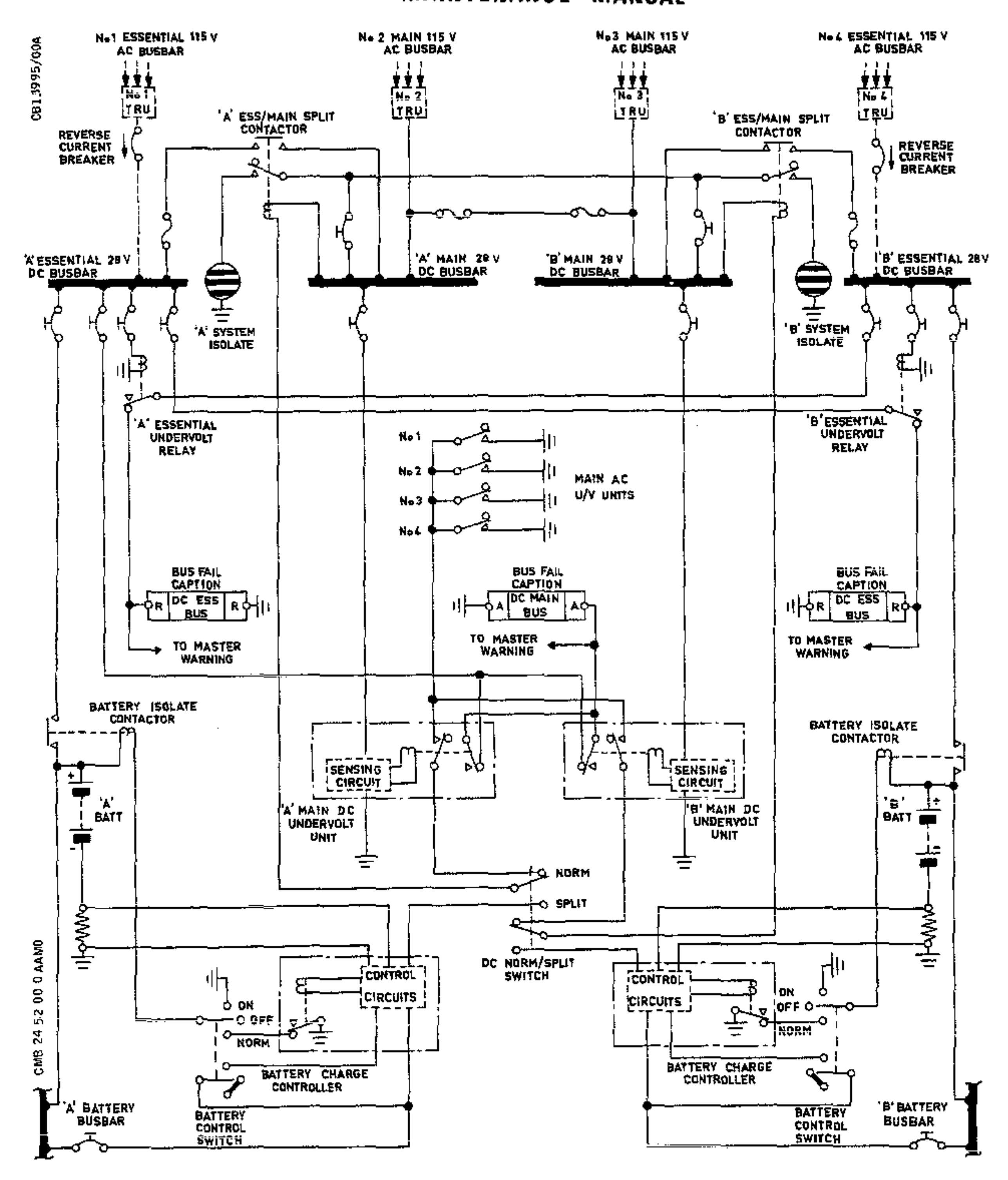
The two main d.c. busbars are interconnected by a cable and two heavy duty fuses, and each essential d.c. busbar is coupled to the associated 'A' or 'B' section of the main d.c. busbar through an essential/main split contactor. The contactors are automatically controlled so that under normal operating conditions all busbars operate in parallel, but in the event of main d.c. busbar failure, or failure of all four main a.c. busbars, the essential/main split contactors are opened to separate the main and essential d.c. busbars. Auxiliary contacts of each essential/main split contactor are associated with the Warning and Landing Display System (Ref. 22-41-00). Both essential main/split contactors can also be controlled by a DC NORM/SPLIT switch, which provides manual control for the connection/disconnection of both essential d.c. busbars to/from the main d.c. busbar (Ref. 24-31-00).

**ON A/C 001-006,

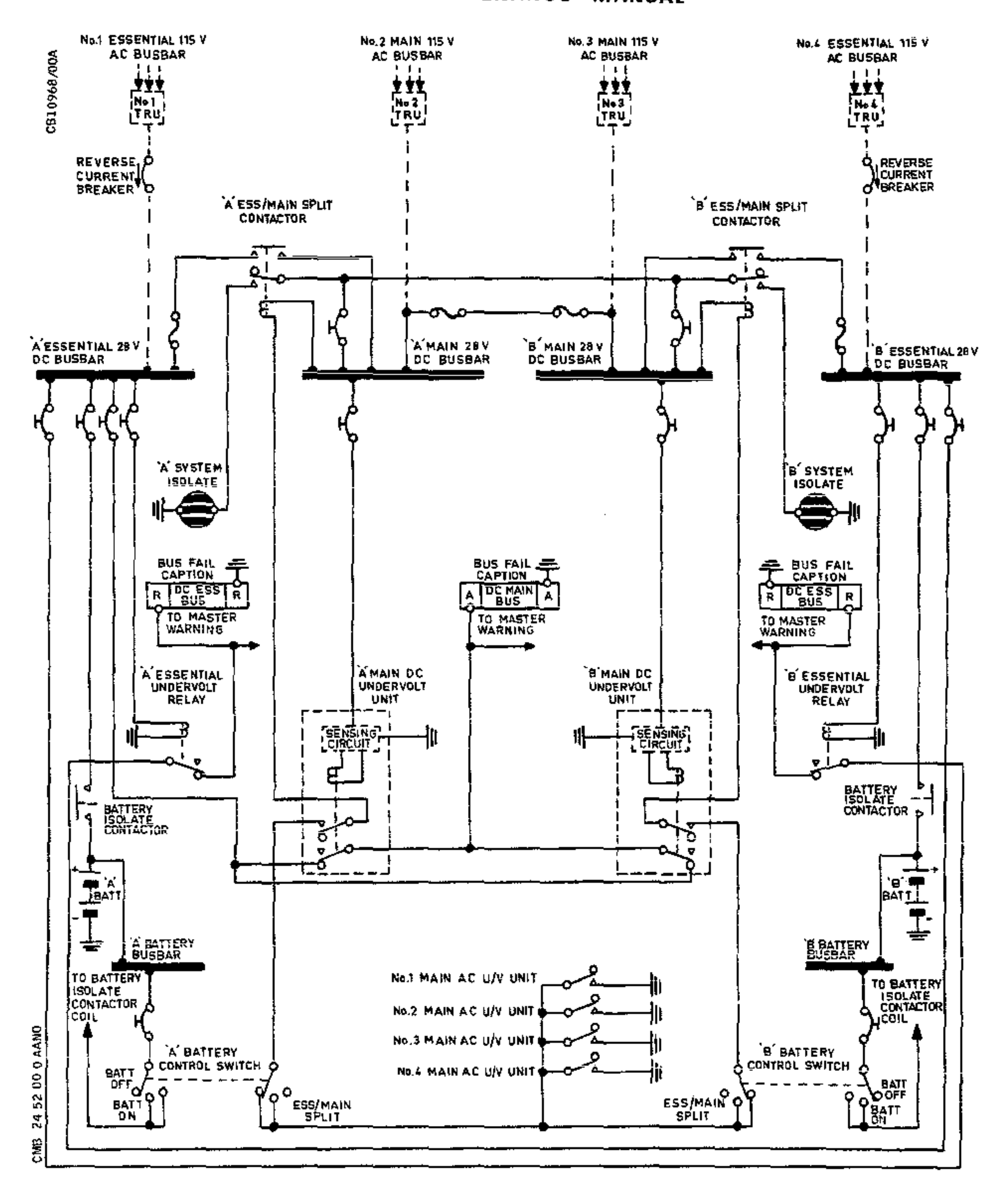
1. General (Ref. Fig. 002)

28 V d.c. power from the four transformer rectifier units (Nos.1, 2, 3 and 4 TRUs) of the d.c. generation system is distributed through two main and two essential 28 V d.c. busbars.

The d.c. distribution system is divided into two sub-systems to form sub-system 'A' and sub-system 'B', each sub-system containing a d.c. main and a d.c. essential busbar. The 28 V d.c. outputs from Nos.2 and 3 TRUs are fed direct to 'A' and



- DC Distribution - Simplified Schematic
Figure 001



- DC Distribution - Simplified Schematic
Figure 002

'B' sub-system main d.c. busbars respectively. Similar outputs from Nos.1 and 4 TRUs are fed to sub-system 'A' and 'B' essential d.c. busbars respectively through a reverse current breaker (RCB); each essential d.c. busbar can also be supplied from an associated battery (Ref. 24-31-00).

The two main d.c. busbars are interconnected by a cable and two heavy duty fuses, and each essential d.c. busbar is coupled to the associated 'A' or 'B' section of the main d.c. busbar through an essential/main split contactor. The contactors are automatically controlled so that under normal operating conditions all busbars operate in parallel, but in the event of main d.c. busbar failure, or failure of all four main a.c. busbars, the essential/main split contactors are opened to separate the main and essential d.c. busbars. Auxiliary contacts of each essential/main split contactor are associated with the Warning and Landing Display System (Ref. 22-41-00). Each essential/main split contactor can also be controlled by a battery control switch associated with each sub-system, thus providing manual control for the connection/disconnection of either or both d.c. essential busbars to/from the main d.c. busbar (Ref. 24-31-00).

In each sub-system, a magnetic indicator indicates interconnection or disconnection of the relative essential d.c. busbar from the main d.c. busbar, and a warning caption associated with each essential d.c. busbar indicates any significant loss of busbar voltage. A d.c. main bus fail caption, common to both sub-systems, warns of any significant loss of voltage at the main d.c. busbars. Undervoltage warning signals operating the warning captions are also applied to the master warning system (Ref. 33-15-00).

In each sub-system automatic switching of the essential/main split contactor and main d.c. bus warning indication is effected by a d.c. undervolt unit connected to the associated section of the main d.c. busbar. Automatic switching of the essential d.c. bus warning caption is controlled by an essential undervolt relay connected to the associated essential d.c. busbar.

The d.c. distribution circuit breaker panels are located in the flight compartment, and the controls, indicators and warning captions are mounted on the lower section of the electrical generating control panel at the third crew member's station. Contactors, relays, fuses and undervolt units are housed in the flight compartment left-hand and right-hand racking.

**ON A/C 007-007,

2. Main 28 V DC Distribution (Ref. Fig.001 and 003)

**ON A/C 001-006,

2. Main 28 V DC Distribution (Ref. Fig.002 and 003)

The main 28 V d.c. busbars comprise cable links and terminal blocks mounted on panel 15-215 ('A' main d.c. busbar), and panel 15-216 ('B' main d.c. busbar), and are linked to distribution circuit breakers on the same panels. 'A' and 'B' main d.c. busbars are fed from 28 V d.c. supplies from Nos.2 and 3 TRUs respectively.

Two d.c. undervolt units connected one to each section of the main d.c. busbar detect loss of busbar voltage, control automatic switching of the associated essential/main split contactor and initiate a main d.c. busbar undervolt warning signal to illuminate a MAIN DC BUS caption.

**ON A/C 007-007,

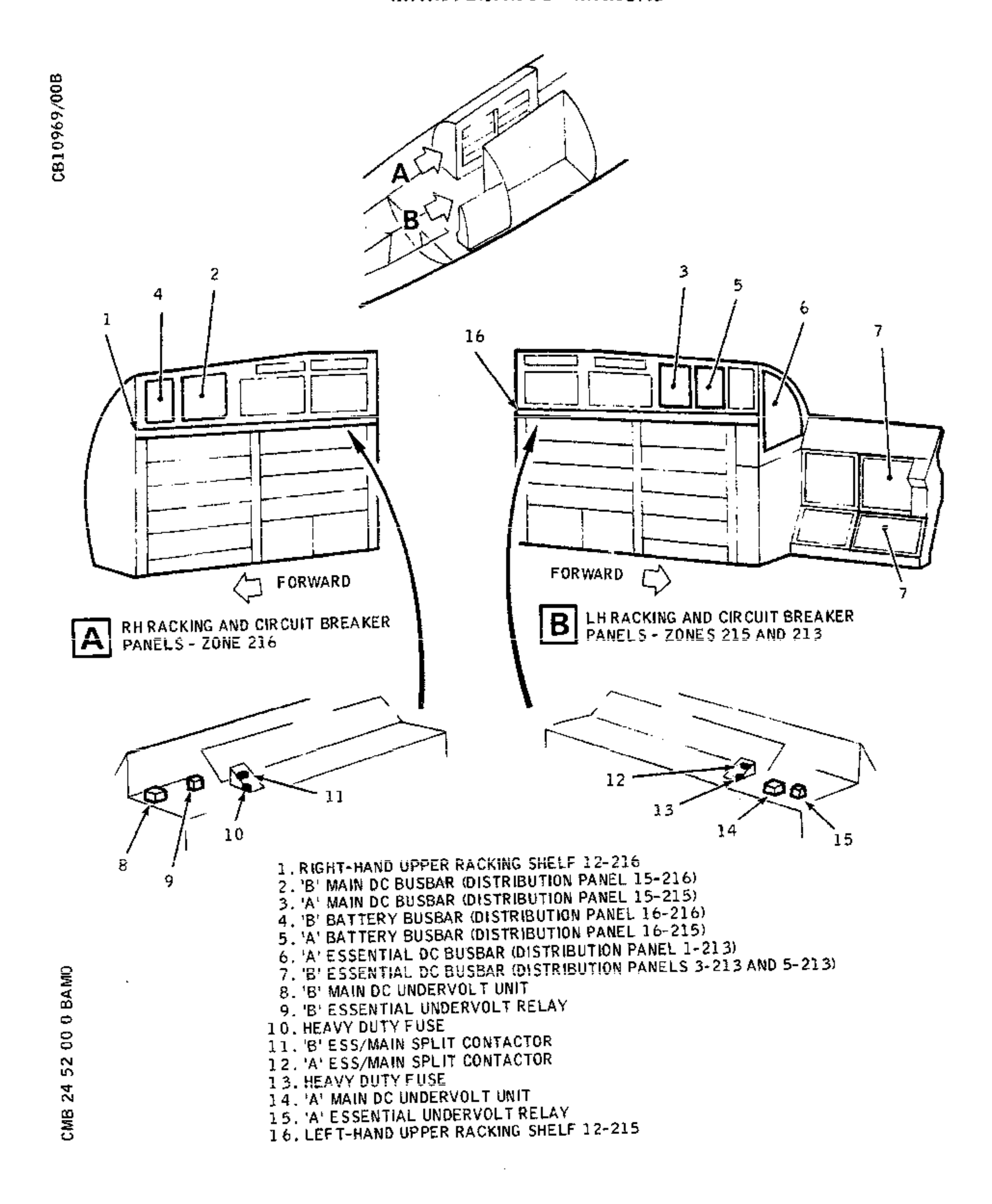
3. Essential 28 V DC Distribution (Ref. Fig.001 and 003)

**ON A/C 001-006,

3. Essential 28 V DC Distribution (Ref. Fig.002 and 003)

The essential 28 V d.c. busbars comprise cable links and terminal blocks mounted on panel 1-213 ('A' essential d.c. busbar), and panels 3-213 and 5-213 ('B' essential d.c. busbar), and are linked to distribution circuit breakers on the same panels. 'A' and 'B' essential d.c. busbars are fed from 28 V d.c. supplies from Nos.1 and 4 TRUs respectively and/or from batteries of the d.c. generation system (Ref. 24-31-00).

Each essential d.c. busbar is normally connected to the associated 'A' or 'B' part of the main d.c. busbar by closure of the appropriate essential/main split contactor. Each contactor is automatically controlled by the associated d.c. undervolt unit sensing the voltage of the respective 'A' or 'B' part of the main d.c. busbar. The earth return of the automatic control circuits is commoned and routed through contacts of four main a.c. undervolt units (Ref. 24-51-00). This ensures that both essential/main split contactors are opened automatically on failure of all four main a.c. busbars.



Location of Equipment
Figure 003

**ON A/C 007-007,

The automatic control circuit of each essential/main split contactor is also routed through the contacts of a DC NORM/SPLIT switch. This provides a manual control facility for the disconnection of the appropriate essential d.c. busbar from the main d.c. busbar.

The associated 'A' or 'B' battery control switch provides primary control of a battery isolate contactor which connects the associated battery and battery busbar to the appropriate d.c. essential busbar; each battery isolate contactor is normally subject to automatic control by an associated battery charge controller (Ref. 24-31-00).

**ON A/C 001-006,

The automatic control circuit of each essential/main split contactor is also routed through a separate pole of the associated 'A' or 'B' battery control switch. This provides a manual control facility for the disconnection of the appropriate essential d.c. busbar from the main d.c. busbar.

Each battery control switch also controls the operation of a battery isolate contactor which connects the associated battery and battery busbar to the appropriate d.c. essential busbar (Ref. 24-31-00).

Two undervolt relays connected one to each essential d.c. busbar detect loss of busbar voltage and initiate busbar undervolt warning signals to illuminate the appropriate DC ESS BUS caption.

**ON A/C 007-007,

4. Battery Busbar Distribution (Ref. Fig.001 and 003)

**ON A/C 001-006,

4. Battery Busbar Distribution (Ref. Fig.002 and 003)

The battery busbars comprise cable links between circuit breakers, those of 'A' battery busbar being mounted on panel 16-215 and those of 'B' battery busbar on panel 16-216.

'A' and 'B' battery busbars are linked to their respective 'A' and 'B' batteries. Whereas battery power supplies are distributed to essential services by the interconnection of battery and d.c. essential busbars in each sub-system, certain

battery control and indication circuits, and a small number of other services only are served by the battery busbars.

**ON A/C 007-007,

5. DC Undervolt Units (Ref. Fig.001 and 003)

**ON A/C 001-006,

5. DC Undervolt Units (Ref. Fig.002 and 003)

The 'A' main d.c. undervolt unit is mounted in the flight compartment left-hand racking on shelf 12-215, and 'B' main d.c. undervolt unit in the right-hand racking on shelf 12-216.

Each undervolt unit comprises a voltage sensing circuit and a relay with two sets of change-over contacts.

Each d.c. undervolt unit senses the voltage of the main d.c. busbar to detect an undervoltage condition and provides internal switching to control external circuits. The relay is energized when the busbar voltage rises above a predetermined level and de-energized if the voltage falls below this level.

**ON A/C 007-007,

6. Operation

A. Control and Indication (Ref. Fig. 004)

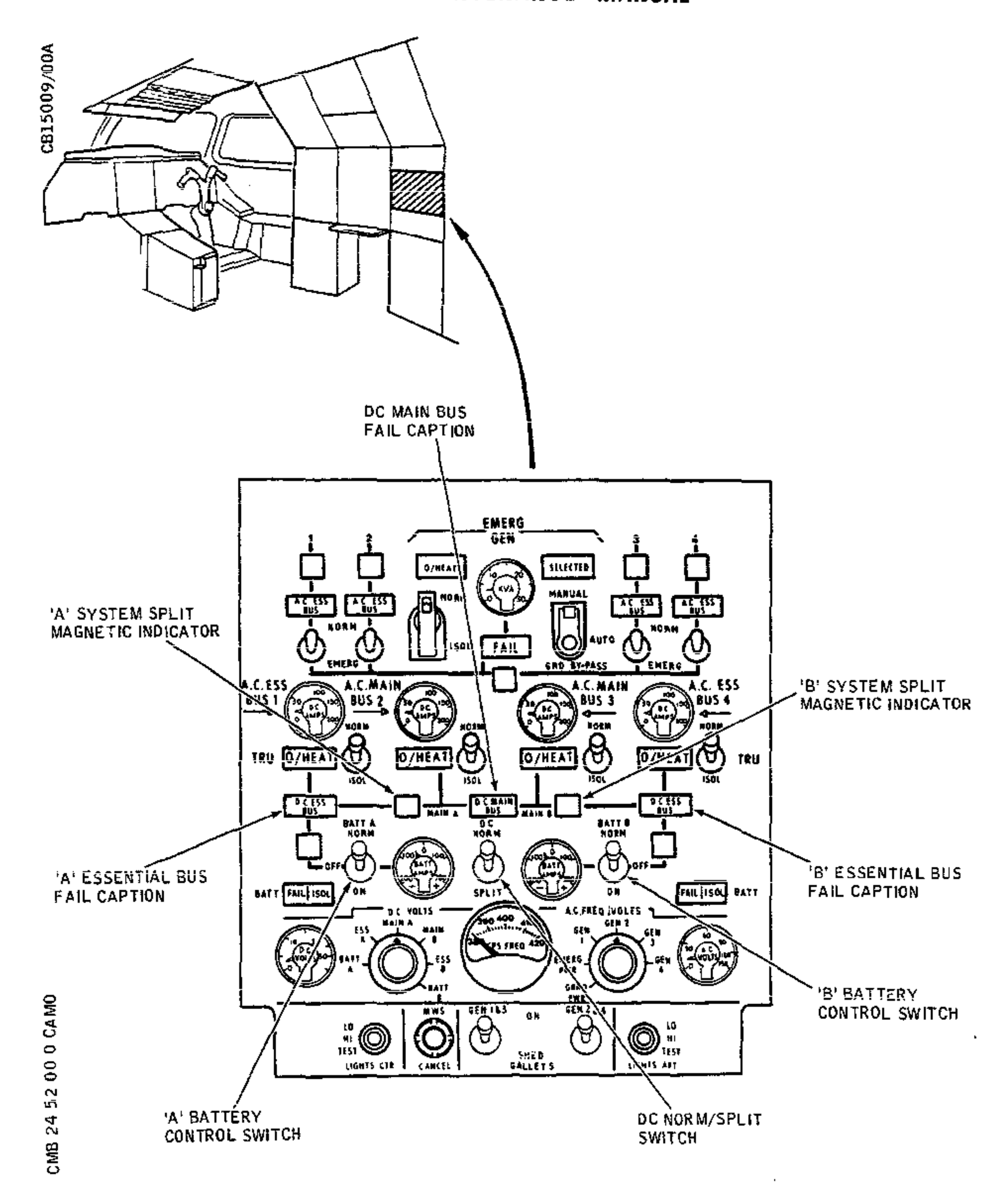
**ON A/C 001-006,

6. Operation

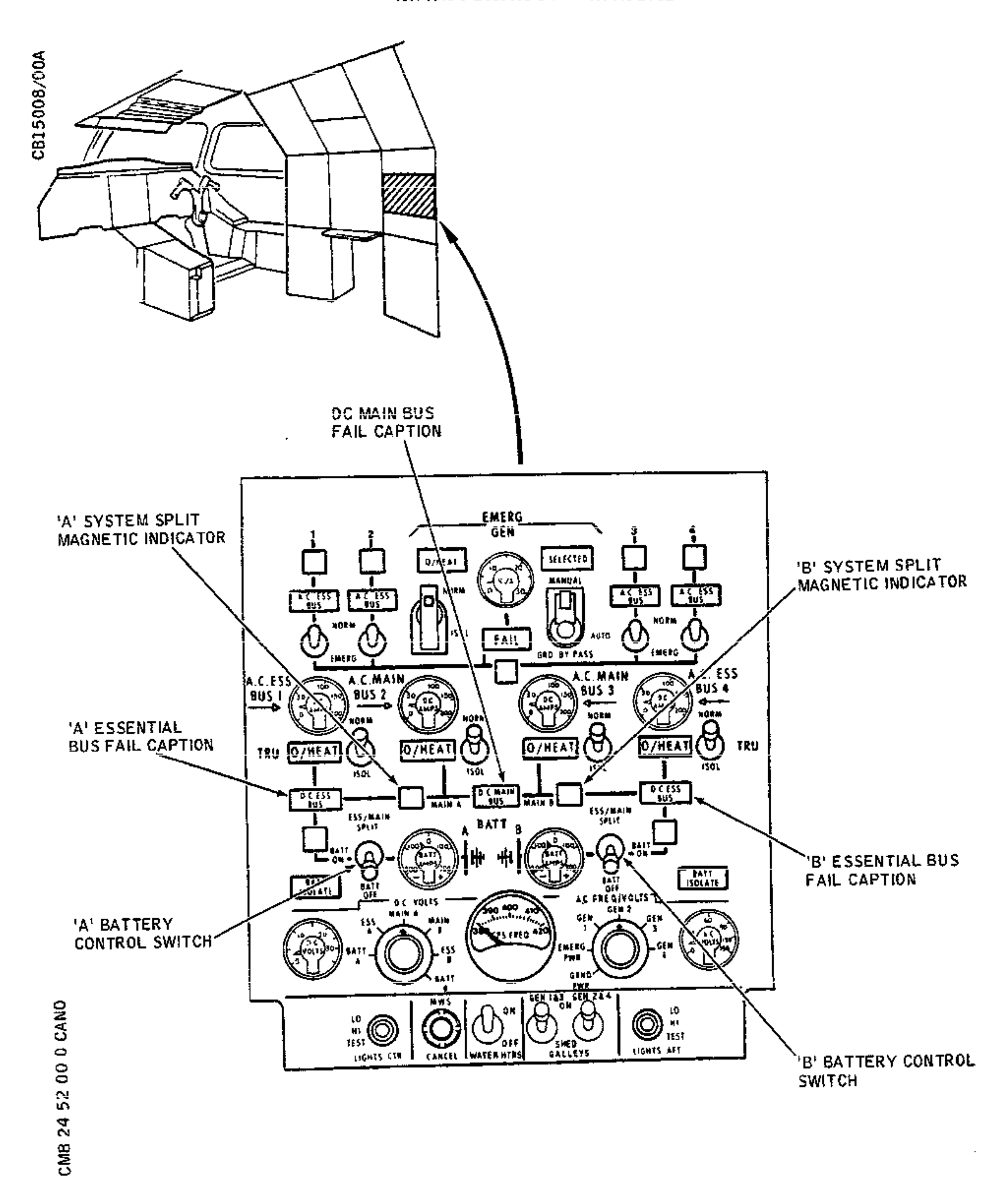
A. Control and Indication (Ref. Fig. 005)

The DC MAIN BUS and the DC ESS BUS fail captions are mounted on the lower section of the electrical generating control panel (panel 6-214) together with the essential/main split magnetic indicators and the battery control switches.

The controls and indicators have interconnecting lines engraved on the panel to form an operational diagram of the distribution system relative to the power supplies. The magnetic indicators show 'in-line' or 'cross-line' in relation to the interconnecting lines to denote the relative 'closed' or 'open' position of the appropriate essential/main split contactor and thus depict connection of the associated main and essential d.c. busbars.



Controls and Indicators
Figure 004



Controls and Indicators
Figure 005

The DC MAIN BUS caption is illuminated if the voltage of either main d.c. undervolt unit falls below the predetermined level. The warning signal that illuminates the DC MAIN BUS caption is also applied to the master warning system (Ref. 33-15-00).

The appropriate DC ESS BUS caption is illuminated if the associated essential undervolt relay is de-energized by a voltage failure on the essential d.c. busbar. The warning signal that illuminates the DC ESS BUS caption is also applied to the master warning system (Ref. 33-15-00).

The DC MAIN BUS and the DC ESS BUS caption lights incorporate a press-to-test facility; the filaments in these caption lights can be tested/dimmed by the flight compartment lights test and dimming facility (Ref. 33-14-00).

**ON A/C 007-007,

The battery control switch for each sub-system is located below the associated DC ESS BUS captions. Each switch has three positions, effective as follows:-

(1) NORM: Battery connection/disconnection to/from essential d.c. busbar is controlled by the associated charge controller.

(2) OFF: Battery disconnected from the associated essential d.c. busbar.

(3) ON: Battery connected to the associated essential d.c. busbar, overriding the charge controller.

The DC NORM/SPLIT switch is located beneath the DC MAIN BUS caption. The switch has two positions, effective as follows:-

(1) NORM: The automatic control circuits of both essential/main split contactors are completed and the main and essential d.c. busbars are thus normally connected.

(2) SPLIT: The automatic control circuits of both essential/main split contactors are interrupted and battery charge controller operation is modified so that the main and essential d.c. busbars are separated and the battery busbars and the d.c. essential busbars are constantly connected.

B. Functional Description (Ref. Fig. 001)

Under normal operating conditions both battery control switches and the DC NORM/SPLIT switch are set at NORM. Battery connection to the associated d.c. essential busbar is therefore controlled by the associated charge controller as described in the d.c. generation system (Ref. 24-31-00). With normal operation of that system, the two RCBs are closed and the outputs from the four TRUs are applied in parallel to the two main and two essential d.c. busbars.

**ON A/C 001-006,

The battery control switch for each sub-system is located below the sub-system DC ESS BUS captions. Each switch has three positions, effective as follows:-

(1) BATT OFF: the battery busbar is disconnected from the essential d.c. busbar.

(2) BATT ON: the battery busbar is connected to the essential d.c. busbar.

(3) ESS/MAIN SPLIT: the battery busbar is connected to the essential d.c. busbar, and the automatic control circuit of the corresponding sub-system essential/main split contactor is interrupted to separate the essential and main d.c. busbars.

B. Functional Description (Ref. Fig. 002)

Under normal operating conditions each battery control switch is set at BATT ON, thus energizing the battery isolation contactors which close to connect the batteries to the essential d.c. busbars. With normal operation of the d.c. generation system (Ref. 24-31-00) the two RCBs are closed and the outputs from the four TRUs are applied in parallel to the two main and two essential d.c. busbars.

At each 'A' and 'B' part of the main d.c. busbar an undervolt unit senses the voltage of the 28 V d.c. supply and energizes the internal relay when the voltage rises to 25.5 V, approximately. In consequence, and provided that one or more of the main a.c. undervolt units are energized (Ref. 24-51-00), the essential/main split contactors are energized and so connect each essential d.c. busbar to its associated part of the main d.c. busbar and the appropriate magnetic indicator displays 'in-line'. 28 V d.c. power supplies are thus available

for associated services at the 'A' and 'B' parts of the main d.c. busbar and the two essential d.c. busbars.

If a voltage failure is sensed at the main d.c. busbar the undervoltage unit relay trips when the busbar voltage falls to 25 V, approximately, for a time delay of up to 7 s. In consequence the essential/main split contactors are de-energized thereby breaking the connection between the main and essential d.c. busbars: 28 V is applied to illuminate the DC MAIN BUS caption and the master warning system is activated (Ref. 33-15-00).

Failure of an essential d.c. busbar de-energizes the associated essential undervolt relay thereby applying a voltage to the DC ESS BUS caption to illuminate the caption, and to activate the master warning system (Ref. 33-15-00).

**ON A/C 007-007,

Setting the DC NORM/SPLIT switch to SPLIT de-energizes both essential/main split contactors, thereby splitting the essential and main d.c. busbar connections and displaying 'cross-line' at the associated magnetic indicators. Battery charge controller operation is simultaneously modified to ensure that each battery is connected to its associated d.c. essential busbar.

**ON A/C 001-006,

Setting a battery control switch to ESS MAIN SPLIT de-energizes the associated 'A' or 'B' essential/main split contactor thereby splitting the corresponding 'A' or 'B' essential and main d.c. busbar connection and displaying 'cross-line' at the associated magnetic indicator.

R

DC UNDERVOLT UNIT - REMOVAL/INSTALLATION

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The two d.c. undervolt units are mounted in the flight compartment racking on shelves 12-215 and 12-216. Each d.c. undervolt unit is secured to the shelf with bolts and washers. Electrical connections are made through a terminal block mounted on top of the undervolt unit cover.

The removal and installation procedures apply to both the 'A' sub-system and 'B' sub-system d.c. undervolt units.

2. DC Undervolt Unit

A. Equipment and Materials

DESCRIPTION	PART NO.
Circuit breaker safety clips	-
Torque screwdriver, 12 to 14 lbf in (0.137 to 0.160 mdaN)	-
Torque spanner, 40 to 45 lbf in (0.452 to 0.509 mdaN)	-

B. Prepare

(1) Isolate the electrical generation and external power supplies as detailed in 24-00-00, Servicing.

(2) Trip the BAT A CONT circuit breaker 1P24 on panel 16-215, or the BAT B CONT circuit breaker 2P24 on panel 16-216, as applicable, and fit a safety clip.

(3) Open the appropriate circuit breaker panel to gain access to 'A' main d.c. undervolt unit on shelf 12-215, or 'B' main d.c. undervolt unit on shelf 12-216.

C. Remove

(1) Remove the undervolt unit terminal block cover and disconnect the electrical cables.

(2) Remove the bolts and washers securing the undervolt unit to the shelf, and remove the unit.

(3) Refit the terminal block cover to the undervolt unit.

D. Install

(1) Comply with the electrical safety precautions.

(2) Place the undervolt unit on the shelf and secure it with the bolts and washers. Torque-tighten the bolts to between 40 and 45 lbf in (0.452 and 0.509 mdaN). Ensure that the unit is bonded in accordance with 20-27-11.

NOTE: In the following operation the toothed lockwasher must be fitted immediately under the terminal screw head and followed by the plain washer.

(3) Connect the electrical cables to the undervolt unit, ensuring that the connections are made in accordance with the cable identifications and the applicable wiring diagram. Torque-tighten the terminal screws to between 12 and 14 lbf in (0.137 and 0.160 mdaN).

(4) Fit the terminal block cover.

E. Conclusion

(1) Close and secure the circuit breaker panel.

(2) Remove the safety clip and reset the circuit breaker tripped in operation B.(2).

(3) Cancel the electrical safety precautions taken in operation B.(1).

(4) Carry out an Operational Test of the d.c. undervolt unit (Ref. Adjustment/Test).

DC UNDERVOLT UNIT - ADJUSTMENT/TEST

WARNING: OBSERVE THE ELECTRICAL SAFETY PRECAUTIONS DETAILED IN 24-00-00.

1. General

The following Operational Test is primarily intended to check the d.c. undervolt unit after installation to confirm that it is operating correctly. Functional and System Tests are not considered necessary in this application.

2. Operational Test

A. Prepare

(1) Make available electrical ground power as detailed in 24-41-00.

**ON A/C 007-007,

(2) Ensure that the BATT A and BATT B control switches are at ON and that the DC NORM/SPLIT switch is at NORM.

R **ON A/C 001-006,

(2) Ensure that the BATT A and BATT B control switches are at BATT ON.

(3) Check that the AC MAIN BUS and AC ESS BUS captions are extinguished.

(4) Check that the DC MAIN BUS caption is extinguished and the essential/main split magnetic indicators show in-line.

B. Test

(1) Trip B SYS MAIN U/VOLT UNIT SUP circuit breaker 2P13 on panel 15-216, map ref.A25. Check that the DC MAIN BUS caption is illuminated and 'B' system essential/main split magnetic indicator changes from in-line to cross-line.

(2) Set Nos.1, 2 and 3 TRU control switches to the "ISOL" position. After a delay (approx. 2 to 10 s) check that the 'A' ESS/MAIN SPLIT magnetic indicator changes from in-line to cross-line.

(3) Set Nos.1, 2 and 3 TRU control switches to the

"NORM" position and check that the 'A' ESS/MAIN SPLIT magnetic indicator changes immediately from cross-line to in-line.

(4) Reset the circuit breaker tripped in operation (1). Check that the DC MAIN BUS caption is extinguished and the 'B' ESS/MAIN SPLIT magnetic indicator changes from cross-line to in-line.

(5) Trip A SYS MAIN U/VOLT UNIT SUP circuit breaker 1P13 on panel 15-215, map ref.A2. Check that the DC MAIN BUS caption is illuminated and 'A' system essential/main split magnetic indicator changes from in-line to cross-line.

(6) Set Nos.2, 3 and 4 TRU control switches to the "ISOL" position. After a delay (approx. 2 to 10 s) check that the 'B' ESS/MAIN SPLIT magnetic indicator changes from in-line to cross-line.

(7) Set Nos.2, 3 and 4 TRU control switches to the "NORM" position and check that the 'B' ESS/MAIN SPLIT magnetic indicator changes immediately from cross-line to in-line.

(8) Reset the circuit breaker tripped in operation (5). Check that the DC MAIN BUS caption is extinguished and the 'A' ESS/MAIN SPLIT magnetic indicator changes from cross-line to in-line.

C. Conclusion

(1) Set BATT A and BATT B control switches to the "OFF" position.

(2) Switch off and disconnect electrical ground power as detailed in 24-41-00.

END OF THIS SECTION

NEXT